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STRATEGIC MARKET PERSPECTIVE

Technology Directions in Systems Integration Markets

U.S. Systems Integration Program

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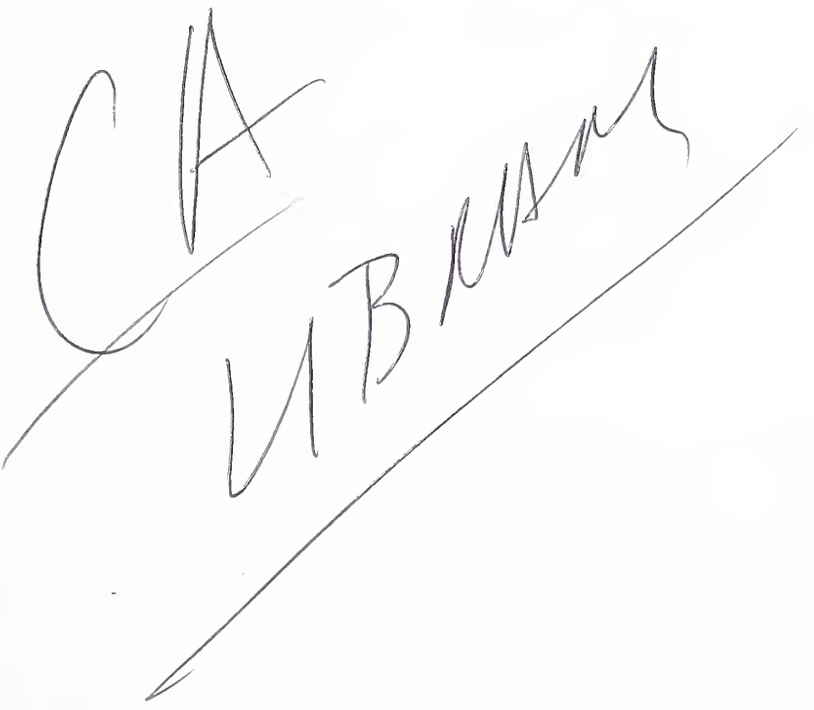
Technology Directions in Systems Integration Markets



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17 Hill Street
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New York
400 Frank W. Burr Blvd.
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U.S.A.
Tel. 1 (201) 801-0050
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Paris
24, avenue du Recteur Poincaré
75016 Paris
France
Tel. +33 (1) 46 47 65 65
Fax +33 (1) 46 47 69 50

San Francisco
1881 Landings Drive
Mountain View
CA 94043-0848
U.S.A.
Tel. 1 (415) 961-3300
Fax 1 (415) 961-3966

Tokyo
Saida Building, 4-6,
Kanda Sakuma-cho
Chiyoda-ku, Tokyo 101
Japan
Tel. +81 3 3864-0531
Fax +81 3 3864-4114

Washington, D.C.
1953 Gallows Road
Suite 560
Vienna, VA 22182
U.S.A.
Tel. 1 (703) 847-6870
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Abstract

Technology Directions in Systems Integration Markets examines the relative importance of key software, information architectures, communications and equipment technologies to the systems integration (SI) community.

Technologies are identified that SI vendors should understand as well as those technologies that during the next five years will require vendors' prioritization.

The report assesses the changing importance of various areas of technology as well as highlighting the factors encouraging and inhibiting the exploitation of these technologies.

Technology Directions in Systems Integration Markets concludes with recommendations on planning for, and introducing, new technologies. Guidelines are presented for the process of managing these technology changes, from identification of market and business needs, through assessment of technology capabilities, to organization and options for technology delivery.

The report contains 66 pages and 49 exhibits and was prepared as part of INPUT's U.S. Systems Integration Program.

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Systems Integration Program

Technology Directions in Systems Integration Markets

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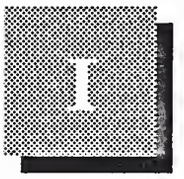

Introduction

A
Scope and Focus of this Report

This report analyzes and reports on technology trends as they are likely to affect Systems Integration (SI), including these key aspects:

- Market needs and technological capabilities
- Factors encouraging and discouraging the use of specific technologies
- The likely actions of leading SI vendors in specific technology areas
- Assessments of overall trends

In addition, the report identifies and recommends the major components of a Technology Action Plan.

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B

Methodology and Information Sources

The principal sources of information for this report have been:

- Interviews with an expert panel of key technology analysts and planners within SI organizations. (Nine formal, structured interviews and over a dozen informal interviews)
- The knowledge base of INPUT's senior staff
- Nonproprietary knowledge and insights gained from custom consulting projects
- Published reports and analyses in trade and technical publications

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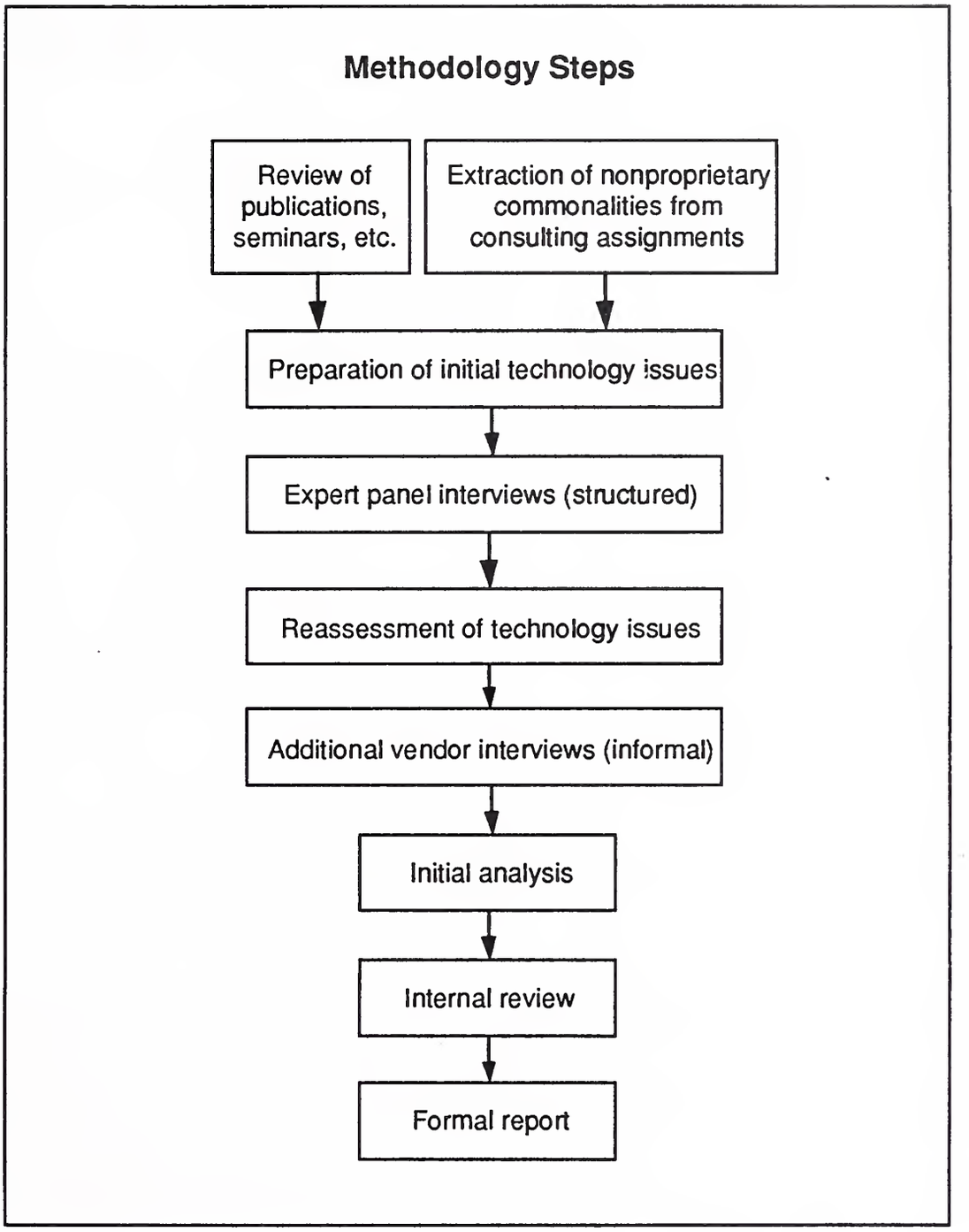
The steps in the analysis are illustrated in Exhibit I-1.

Exhibit I-1



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II

Management Summary

Several technologies are so important and established that INPUT describes them as "pervasive" technologies (see Exhibit II-1).

Exhibit II-1

"Pervasive" Technologies

- Local-area networks
- Enterprise and interenterprise networks
- Open systems/interoperability
- Software engineering

However, there are significant differences between vendor assessments of the importance of technologies. For example, the SI technologists on INPUT's expert panel vary considerably in their current assessments of the importance of local-area network (LAN) technology (see Exhibit II-2). These differences of assessment are caused by a combination of factors, including:

- Technology change
- Focus of a firm's practice
- Differences in facts available and assumptions
- Internal competition for resources

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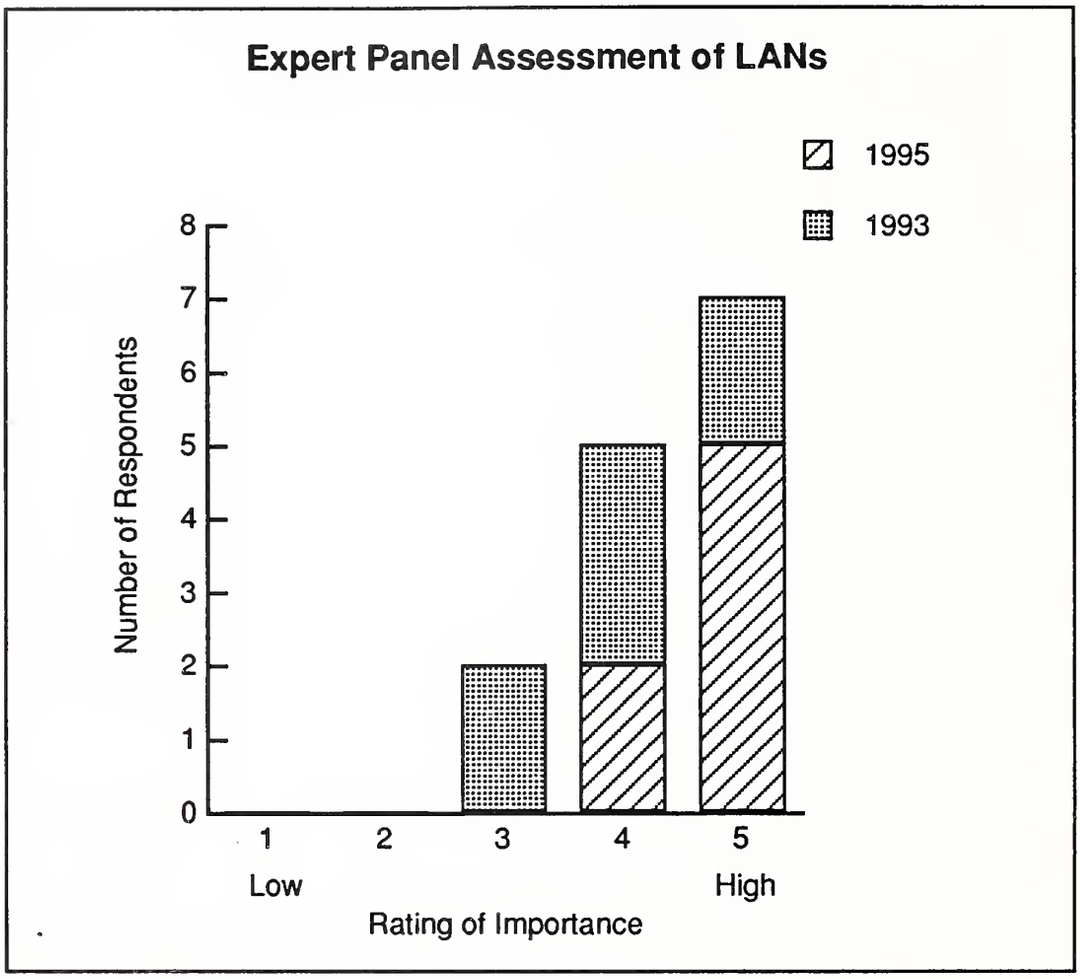
Exhibit II-2



In addition to the pervasive technologies, INPUT expects over a dozen other technologies to be of high- or medium-high importance by 1998 (see Exhibits II-3 through II-5). For these technologies, there is also considerable variation in the importance that different SI vendors give individual technologies.

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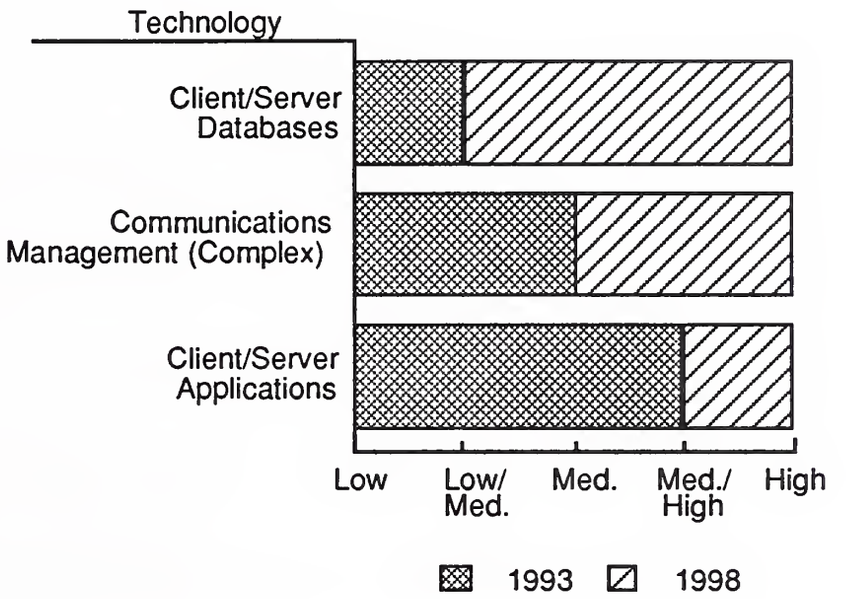
Exhibit II-3

SI-Related Technologies with High Importance in 1998 Compared to 1993 Importance



Source: INPUT Assessment

Exhibit II-4

SI-Related Technologies with Medium/High Importance in 1998 Compared to Importance in 1993

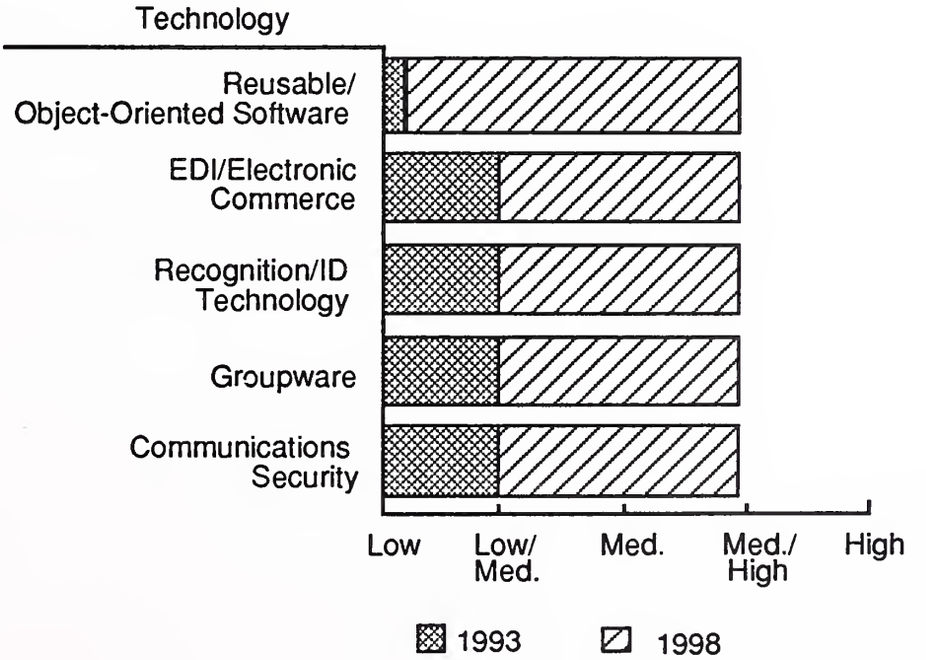


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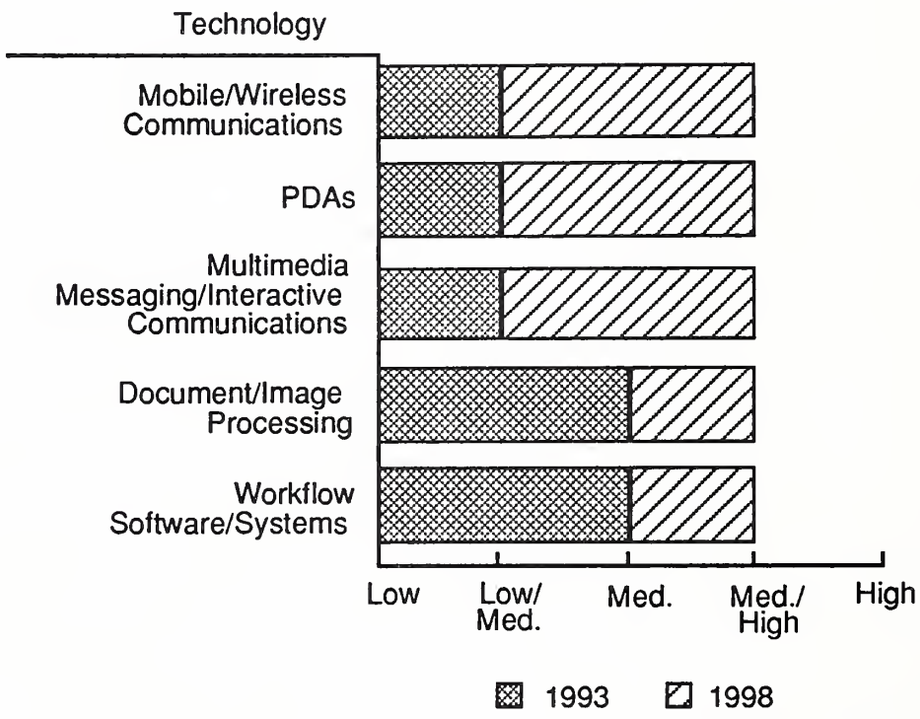
Exhibit II-5

SI-Related Technologies with Medium/High Importance in 1998 Compared to Importance in 1993



Source: INPUT Assessment

INPUT believes that SI vendors should not look at individual technologies in isolation, as is often done, but should look at overall technology options.

- There are linkages between SI technologies. Exhibit II-6 shows one view of such linkages.

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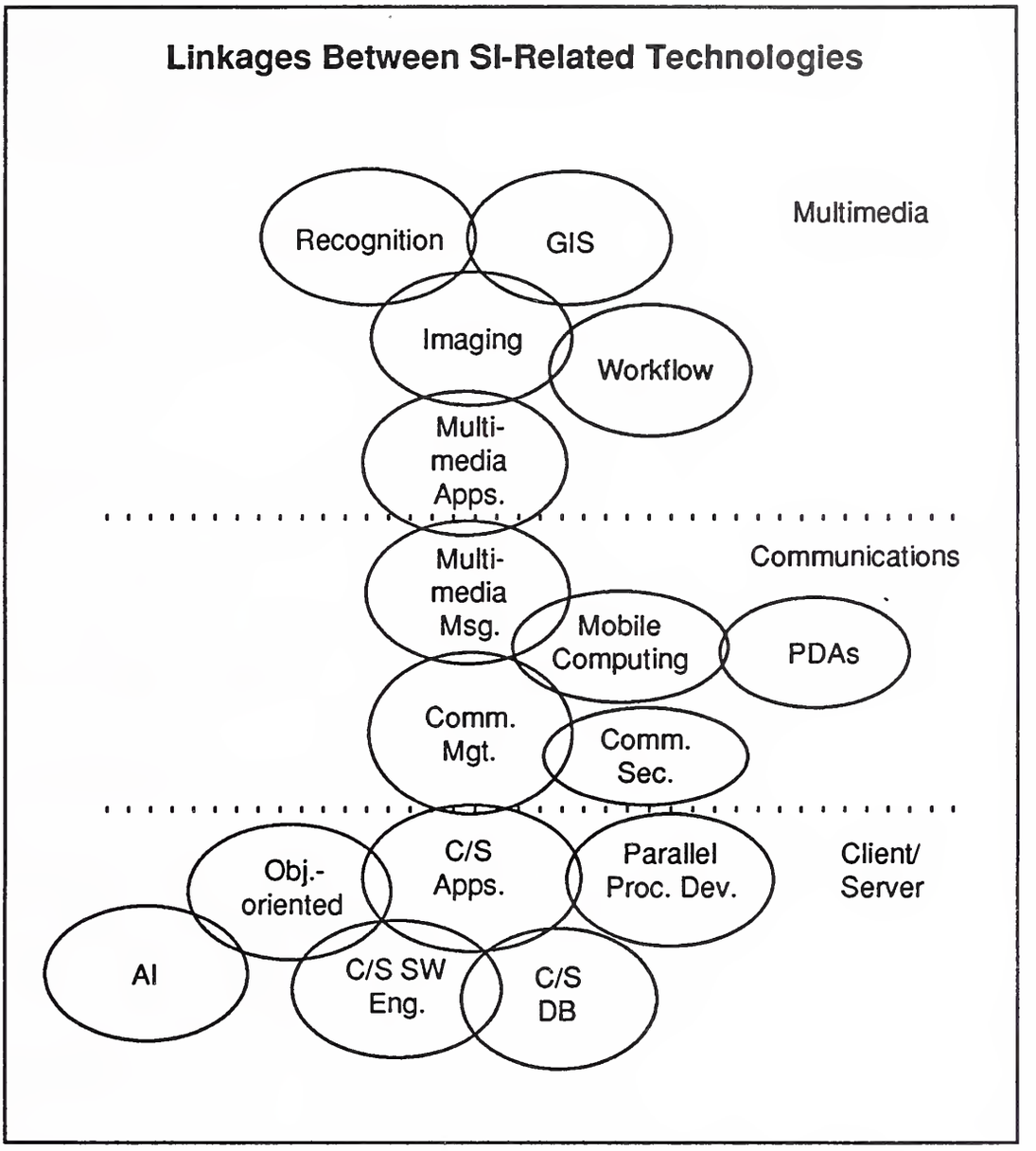
Exhibit II-6



- Each SI vendor should also establish a comprehensive, ongoing process for planning technology insertion into its business. Exhibit II-7 summarizes the components of the recommended Technology Action Plan.

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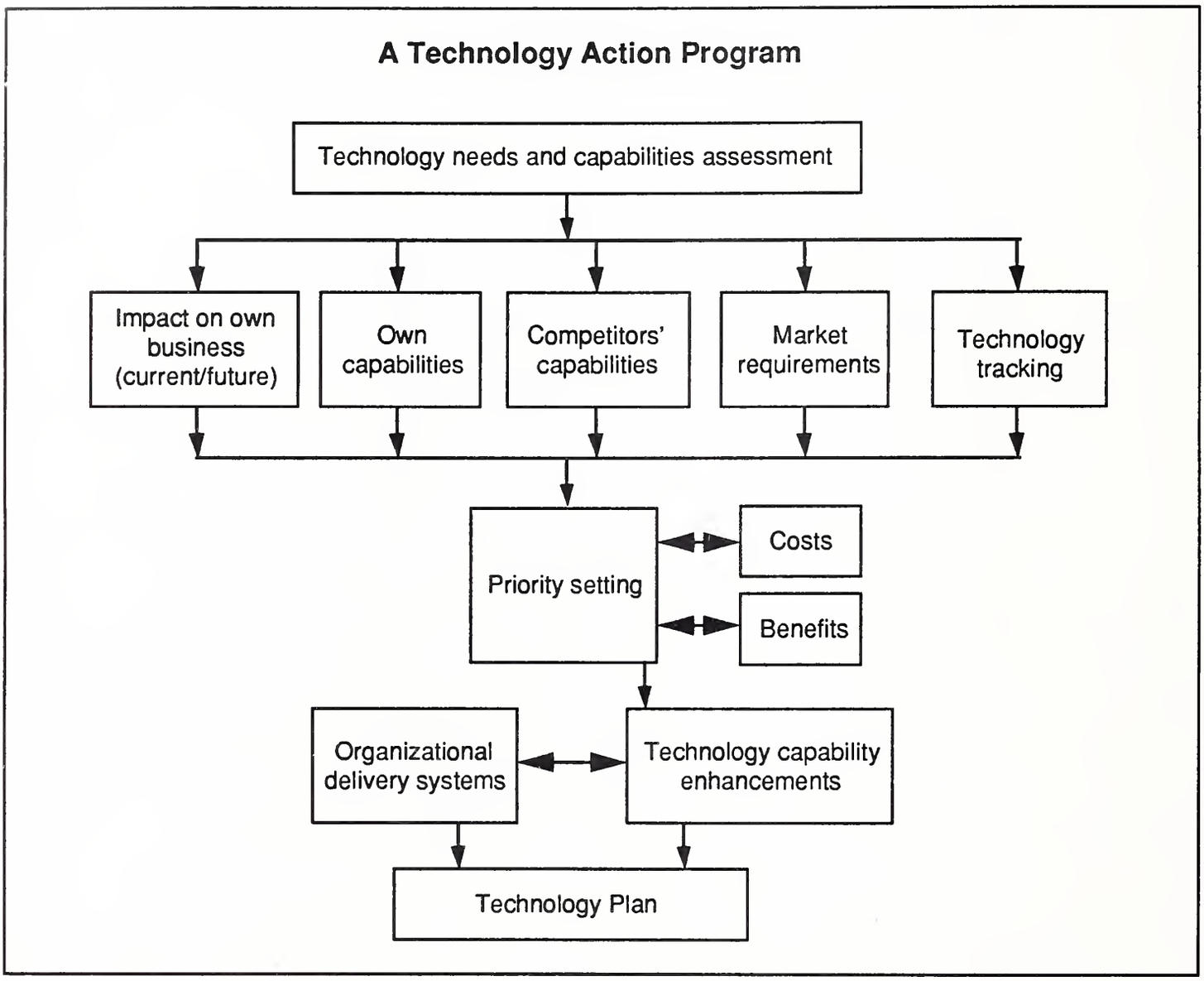
Exhibit II-7



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III

Assessment of Key Technologies

This chapter assesses the importance of two groups of technologies.

- Technologies that are so pervasive that every SI firm should have the capability to understand them (although not necessarily have the resources to implement them)
- Specific technologies that will be important in the next five years. Every vendor may not necessarily need to be an expert in every technology; this will depend on a vendor's focus and direction

A "Pervasive" Technologies

The technologies shown in Exhibit III-1 are already so important that INPUT labels them "pervasive."

Exhibit III-1

"Pervasive" Technologies

- Local-area networks
- Enterprise and interenterprise networks
- Open systems/interoperability
- Software engineering

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- Local-area networks are the basis for, or at least a part of, most new systems' development.

- Larger networks are increasingly the core of systems and/or areas where SI vendors add the most value. Specific technologies include the older ISDN as well as the newer ATM. Exhibits III-2 and III-3 include specific comments from the expert panel on the factors that encourage and discourage SI vendor use of these specific technologies.

Exhibit III-2

Issues Raised by Expert Panel on ISDN

- Factors Encouraging Exploitation of Technology
  - "Exciting" in some niche areas (e.g., call centers)
- Factors Inhibiting Exploitation of Technology
  - Market is a peculiar combination of niches that are saturated and empty
  - Will probably be killed by a combination of ATM and fiber optics (but how will fiber optics get from curb to home?)
  - Has been talked about for a long time but never caught on
  - "Always on the horizon, but never gets any closer"
  - "Commodity technology" of the future

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Exhibit III-3

Issues Raised by Expert Panel on ATM

- Factors Encouraging Exploitation of Technology
  - Is really a standard, not new technology
  - Will this be the broadband ISDN? (Or at least the promise that ISDN once had).
  - Closely tied to mobile computing (could be minus because of this).
- Factors Inhibiting Exploitation of Technology
  - Territory of large telecomm vendors—hard for SI vendors to enter (technology, credibility)
  - How fast will it be established?
  - Could still evolve into something we wouldn't recognize—if so, current work might be wasted
  - Needs critical mass
  - Still very new, not totally understood

- Open systems/interoperability issues are now very important because of mutually reinforcing trends:
  - The network issues enumerated above
  - The decline of traditional, mainframe-driven networks
- If there is any problem with the open systems area it is its very breadth—taken too far, "open systems" can include practically all computing activities. Exhibit III-4 sets out these issues from the vendor's perspective.

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Exhibit III-4

Issues Raised by Expert Panel on Open Systems Architecture

- Factors Encouraging Exploitation of Technology
  - In spite of talk, there are a limited number of vendors who can actually execute the technology well.
  - Vendors who make the commitment now may have a head start—competitors won't be able to catch up.
  - Most customer organizations already have some (especially in certain sectors).
  - The larger definition is "any-to-any"—this is where a real opportunity may lie.
  - This looks like it is developing into a "superniche" area, encompassing a series of smaller niches (but may never become large scale).
  - Will be very important if becomes closely associated with client/server systems (this is not the case now)
- Factors Inhibiting Exploitation of Technology
  - What is the definition (from a technology or business sense)? At best, a fuzzy concept.
  - An overall "embarrassment"—it never gets organized
  - No real standards—suppliers must get into line
  - "Getting divorced from one proprietary system to marry another one"
  - May never get really big in terms of market share
  - Hype or real?

- Software engineering is a kind of dark horse among these other technologies. Software engineering itself is somewhat in eclipse because of over-identification with mainframe-based development. However, a new generation of more cautious software engineering, aimed at the client/server environment, will become a critical area of strength and differentiation by the late 1990s. (The specific area of object-oriented development is discussed in the next section.)

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B
Specific Technologies

With the possible exception of software engineering, the technology areas in the "pervasive" group are obvious. There are other groupings, however, of specific technologies that will become more important in the course of the next five years.

The next three exhibits show the technologies that will be of, at least, medium importance by 1998 (and are less so now). For each technology, the importance in 1998 is contrasted with that in 1993. "Importance" is a combination of the following factors:

- Overall market need (measured in dollars spent on the technology)
- Relative contribution of the technology to SI projects
  - This could be positive, in allowing "better, faster, cheaper" development
  - Or negative, in terms of bottlenecks that may arise without the technology being fully developed or fielded
- The relative maturity of the technology at the beginning and end of the time period
- The existence (or nonexistence) of proven applications using the technology.

"Importance" was influenced by the views of the expert panel. However, the final assessment was made by INPUT.

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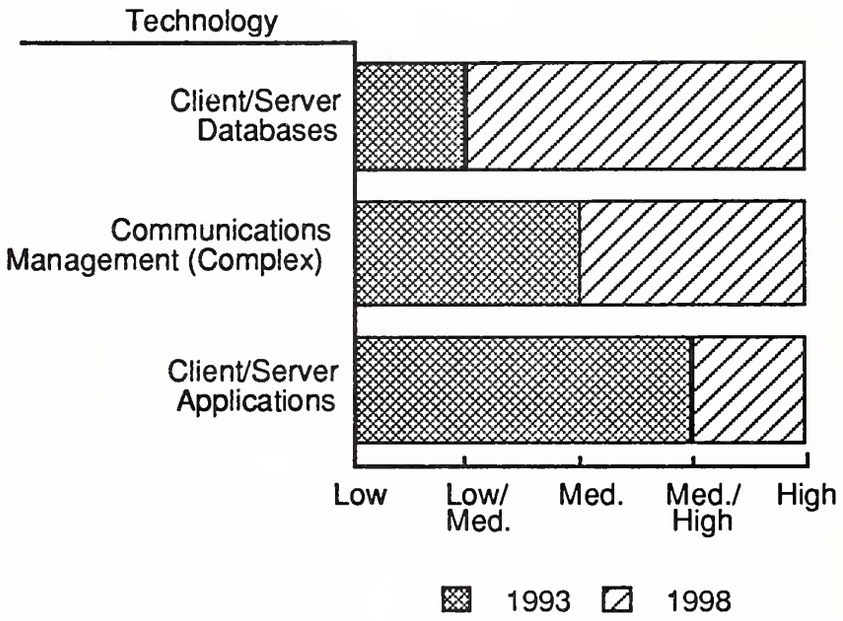
Exhibit III-5 shows the technologies INPUT considers to be most important in 1998.

Exhibit III-5

SI-Related Technologies with High Importance in 1998 Compared to 1993 Importance



Source: INPUT Assessment

- Client/server applications are already extremely important. The increment is basically the last of the mainframe-based applications being pushed aside.

- The management of complex communications will become increasingly important as heterogeneous networks are developed in semi-isolation.

- Client/server database design and engineering will be a critical point of differentiation.

The technologies shown in Exhibit III-6 will be almost as important in 1998 as those in the previous group.

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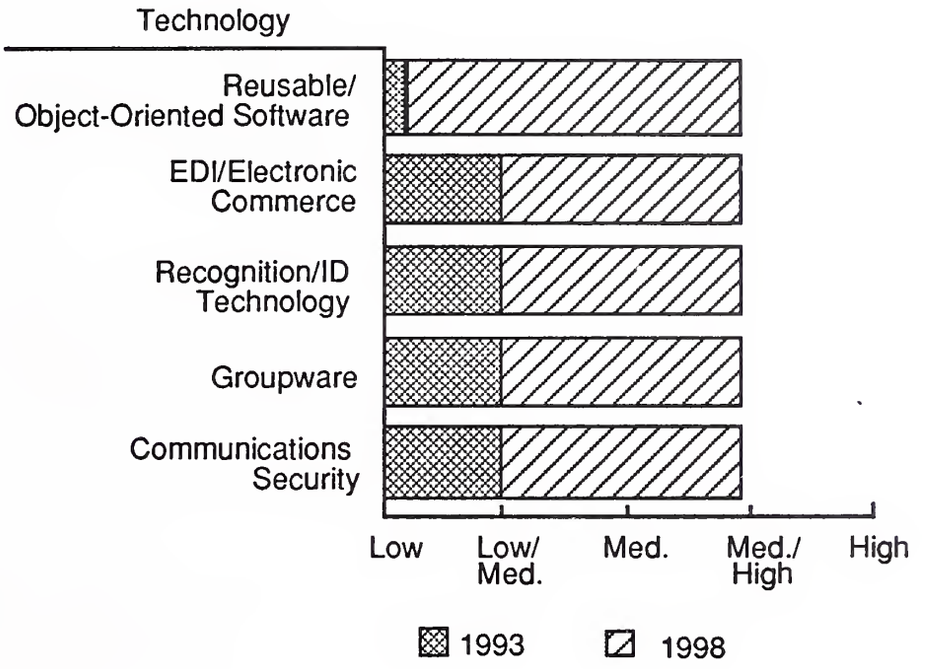
Exhibit III-6

SI-Related Technologies with Medium/High Importance in 1998 Compared to Importance in 1993



Source: INPUT Assessment

- Object-oriented (reusable) software will be very important to the extent that the technology is successful and accepted. INPUT does not expect this to occur until the second half of the time period. This is the major reason why it is not in the "high" category.

- The technologies now in the "low/medium" category are accepted, constantly improving technologies that will be increasingly used within SI projects.

- Imaging and workflow systems are already fairly well positioned and have continued growth and acceptance.

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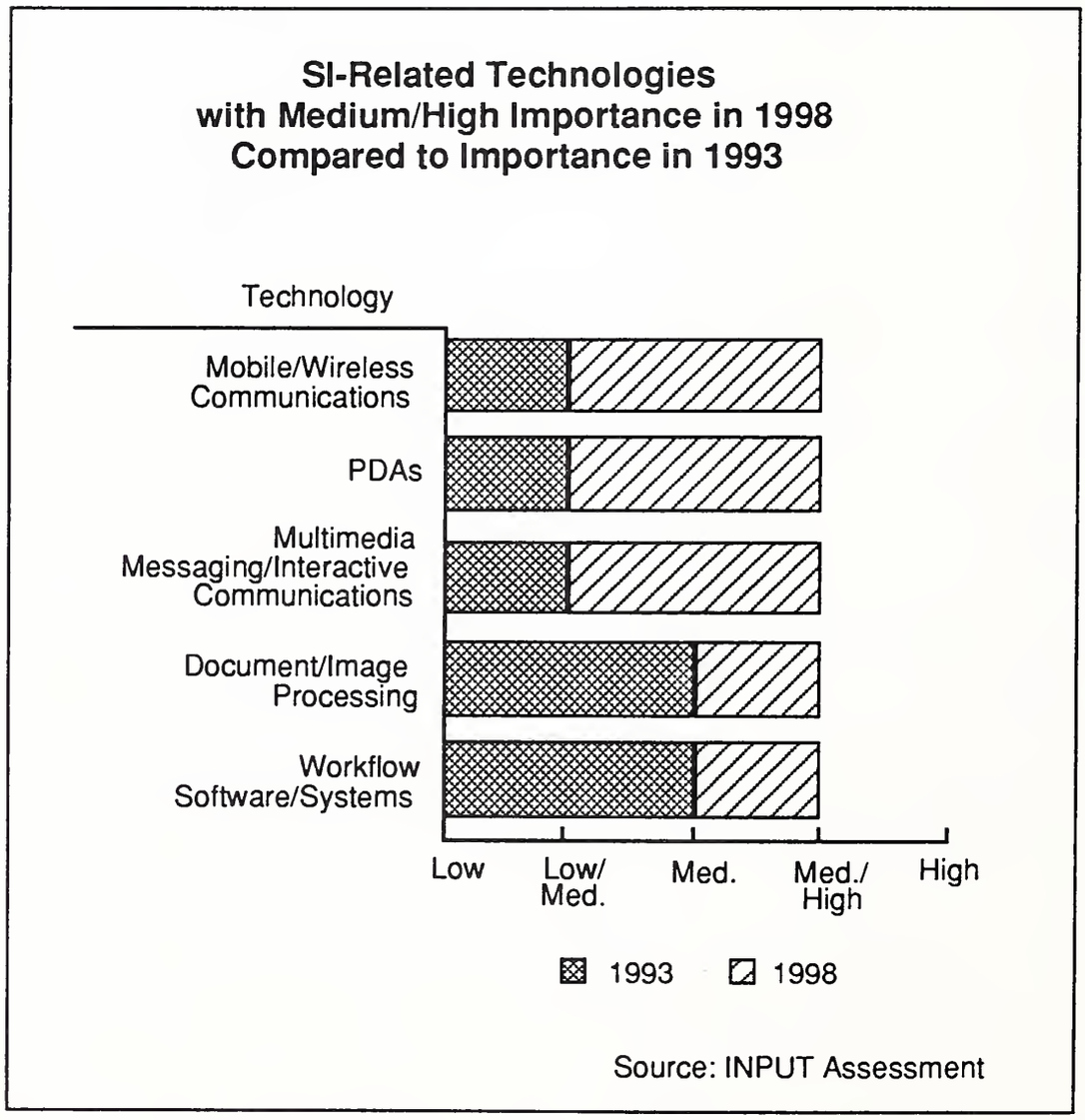
The technologies in Exhibit III-7 are, for the most part, niche technologies that will see good growth, but are unlikely to break out of their niche. Multimedia systems/applications are different in the sense that they are potentially applicable across a wide area of industries. However, INPUT does not expect to see multimedia applications in widespread use until well into the 1990s. (Note: INPUT expects multimedia messaging will become more important sooner, because the use of the technology will be essentially cross-industry in nature.)

Exhibit III-7



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C
Expert Panel's Assessment of Key Technologies

As part of the interview process, the expert panel evaluated specific technology areas and the factors that would encourage or discourage the use of these technologies. (The specific comments made in this section were taken into account in INPUT's assessments made in Exhibits III-5 to III-7.)

A constant thread in these comments is the overall balance between positive and negative vendor assessments. This balance means the following:

- There is not a great deal of consensus over "winners" and "losers" and which technologies must be backed or avoided.
- Many positive and negative "votes" are tentative and likely to be changed, depending on developments in the underlying technology as well as market acceptance.
- Equally competent, capable vendors are likely to adopt strikingly different strategies on specific technological developments.

For convenience, expert panel comments are organized in the same general order as INPUT's technology assessments in Exhibits III-5 to III-7. In a few cases, there are no specific mirroring comments, either because the area is too broad (communications management or security) or because the area was identified late in the assessment process (workflow systems).

Exhibit III-8 contains comments on client/server issues overall. Note how the inhibiting factors are quite starkly negative. This will be a reality for a minority of client/server projects for some time to come. This is why the database issues and, to a large extent, the object-oriented issues will be so important (see Exhibit III-9).

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Exhibit III-8

Issues Raised by Expert Panel on Client/Server Issues

- Factors Encouraging Exploitation of Technology
  - Many, customer organizations are there now (or at least part way there)
  - Already half of the work of the respondent firms' work.
  - Will be well-defined by 1995
  - "Everything" the respondent firms are now doing
  - Technology is driving strategies.
  - Ties closely into evolving systems management business
  - Leads the way for all new high-activity applications
  - Difficulty in performing well in this area is really an encouragement. Those who make the long-term commitment will be very well placed competitively in the future.
- Factors Inhibiting Exploitation of Technology
  - Many client/server applications crash and burn.
  - No real or consistent client/server strategy: "Strategy" changes from implementation to implementation
  - Real "struggle" in 1993 to know how to maintain client/server applications. May not be a general solution even by 1995

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Exhibit III-9

Issues Raised by Expert Panel on Object-Oriented Programming

- Factors Encouraging Exploitation of Technology
  - This is the most important technology of all.
  - Key benefits: Enhancement, maintenance of applications
  - Faster system development
  - Just at beginning of learning/benefit curve
  - Natural paradigm for GUI (Which take up to half of programming resources)
- Factors Inhibiting Exploitation of Technology
  - No real standards yet—or on horizon
  - Have attempted to use NeXT environment: "Painful result"
  - "Too hard"
  - Too many vendors (both product and service)
  - Object-oriented is much more than just programming.
  - Over-hyped—phrase/concept may be becoming counterproductive both technically and in the marketplace
  - Not enough tools—especially those that work
  - In a sense tools are already too powerful: "You can go hang yourself and your neighbor."
  - Really a methodology or approach to systems development rather than a toolset; the technology *per se* is less important
  - Excellent single person productivity aid—but so far, poor for group efforts
  - Could end up building "standard libraries" forever, (i.e., libraries turn out not to really be standard, but contain modules with many subtle differences that contain more trouble than benefits).

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Exhibits III-10 through III-19 report the issues raised by the expert panel.

Exhibit III-10

Issues Raised by Expert Panel on EDI/Electronic Commerce

- Factors Encouraging Exploitation of Technology
  - Especially useful in niches of manufacturing, government or retailing
  - A "superniche"?
  - Health care will be a driver.
  - Could take off with more standardized applications
- Factors Inhibiting Exploitation of Technology
  - May need open systems as an enabler—lack of growth in open systems may slow this down
  - EDI may only be an interim technology. Other communications-based technologies, such as multimedia, could expand or compete with
  - Not very much labor content for SI firms
  - U.S. is behind Europe and Japan

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Exhibit III-11

Issues Raised by Expert Panel on Speech Recognition/ID Technology

- Factors Encouraging Exploitation of Technology
  - Strong positive reaction to demo tapes
  - Some specialized applications (e.g., telcos)
  - Microsoft support helps drive value
- Factors Inhibiting Exploitation of Technology
  - Not a lot of recognition yet—on either the vendor or customer side. People just don't think of voice recognition outside of already-exploited niches.
  - Not real yet
  - Hardware is key—still have to talk slowly in many cases; hard to handle accents
  - Mainly a curiosity today
  - Need to find "killer" application (or any application outside of telcos?)

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Exhibit III-12

Issues Raised by Expert Panel on Groupware

- Factors Encouraging Exploitation of Technology
  - Lotus Notes has done a lot to raise consciousness (both of vendors and in the customer community)
  - "Will shoot by object technology"
  - "Sensitive to the human metaphor"
  - Used internally (within respondent's firm) for transport/backbone/utility for communications; becoming embedded in way of working and because of this will ultimately have a big impact on building systems for customers
  - DB applications linkages are important.
  - Intersects with workflow (but not as directly as imaging)
  - Will probably have figured out how to get around problems (cultural, software, design) by 1995
  - This will be the next big revolution.
- Factors Inhibiting Exploitation of Technology
  - The industry has been talking about this "for ages".
  - Real uses are mostly in niche areas (e.g., engineering).
  - Not doing much actual business in this at the moment
  - Doesn't work very well today (but "mandatory" by 1995)
  - Often needs a culture change to get full benefit from applications using this technology
  - The enabling software needs to be less intrusive than at present.

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Exhibit III-13

Issues Raised by Expert Panel on Mobile Computing

- Factors Encouraging Exploitation of Technology
  - Demonstrations are creating demand.
  - Closely linked to PDAs
  - Software behind the hardware is advancing.
  - AT&T is behind it.
  - "Explosive growth" in a few vendor-client applications: Shows there is in fact potential
- Factors Inhibiting Exploitation of Technology
  - Could be a sleeper if "killer" applications are found.
  - Don't see much evidence of it today
  - Don't know where it is going.
  - Will Microsoft and Intel really support it?
  - Both awareness and cost are negatives now.
  - How will applications be maintained?
  - "Neat, but a bit player?"

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Exhibit III-14a

Issues Raised by Expert Panel on PDAs

- Factors Encouraging Exploitation of Technology
  - "Explosion getting ready to happen"
  - Closely linked to wireless/mobile computing
  - By 1995, "the wave of the future"
  - May be more of a personal productivity tool than for group use
- Factors Inhibiting Exploitation of Technology
  - Clients aren't requesting the technology.
  - Can't visualize what the "killer application" will be
  - Still in infancy
  - Market still looking to define itself; players jockeying for position
  - Lack of software today, lack of bandwidth

Exhibit III-14b

Issues Raised by Expert Panel on Pen-Based PDA Systems

- Factors Encouraging Exploitation of Technology
  - "Wild enthusiasm" among customers—two of three initial proposals accepted
  - Makes "walking computing" possible
  - Service industry is a key target.
  - SI consultants, themselves, may be among the first to use.
- Factors Inhibiting Exploitation of Technology
  - Doesn't work well enough yet
  - Handwriting recognition poor
  - Will not be ready by 1995

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Exhibit III-15 .

Issues Raised by Expert Panel on Multimedia

- Factors Encouraging Exploitation of Technology
  - Increased use in training and direct customer interaction
  - Lots of excitement and vendors showing capabilities
- Factors Inhibiting Exploitation of Technology
  - No "killer" applications
  - Finding real life applications is a problem
  - Price/performance still an issue
  - Speech synthesis must get better.
  - Systems using multimedia need to be designed differently than conventional systems.
  - Full motion video is important.
  - Effort to make it work versus added value often not proportionate

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Exhibit III-16

Issues Raised by Expert Panel on Document/Image Processing

- Factors Encouraging Exploitation of Technology
  - Will be part of systems mainstream by 1995
  - A very important piece of workflow and BPR analysis
  - Still at an early stage
  - By 1995: Low-cost servers and cheap mass storage
  - "Poised for the masses"
  - "Hot," "A must-have"
- Factors Inhibiting Exploitation of Technology
  - Few solid implementations
  - Largely in the training and information gathering phase to date
  - Technology and costs are not quite there.
  - Not as pervasive as, say, PCs or DBMS (to put into perspective)
  - Still learning how to apply in many cases

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Exhibit III-17

Issues Raised by Expert Panel on Parallel Processing

- Factors Encouraging Exploitation of Technology
  - Applicable to high-volume client/server
  - Will be software-enabled by 1995
  - Respondent firm believes it is "preeminent."
- Factors Inhibiting Exploitation of Technology
  - No "killer" application
  - More complex than people think
  - Not really suited for branching (i.e., business) applications
  - "Lots of talk, little action"
  - Few development tools
  - Will not be ready by 1995

Exhibit III-18

Issues Raised by Expert Panel on Geographic Information Systems

- Factors Encouraging Exploitation of Technology
  - Important in a few niche markets (oil and gas, mapping applications)
  - Looks good, lots of media attention
  - Will be more mature in two years
- Factors Inhibiting Exploitation of Technology
  - Pure technology not as important as understanding how it fits into applications.
  - Specific applications knowledge is often still missing or can't be demonstrated.
  - Tough to compete

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Exhibit III-19

Issues Raised by Expert Panel on Artificial Intelligence/Expert Systems

- Factors Encouraging Exploitation of Technology
  - The respondent's firm in putting together a "knowledge base" to use on classes of applications
  - Somewhat important but invisible—usually embedded within a larger system or application
  - Good for some specialized applications
- Factors Inhibiting Exploitation of Technology
  - What do you use it for?
  - If there is an opportunity it is not AI, as usually understood, but fuzzy logic/neural networks—although maybe we're just exchanging and old fad for a new one
  - Neural networks—but probably much later than 1995
  - This is a niche market.
  - Not enough tools
  - No "killer" application
  - Formerly a silver bullet, now used from time to time where it makes sense

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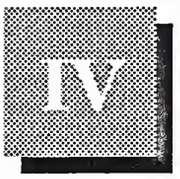

Expert Panel Ratings of Technology

In Chapter III, INPUT provided a consensus rating of technologies based on its collective judgment, plus the overall assessment of its expert panel. This chapter looks more depth at the individual assessments made by its expert panel. This detail goes even further than the more qualitative assessments reported in Section C of Chapter III.

For this section of analysis, the panel was requested to rate the importance of a technology in 1993 and in 1995 on a scale of 1 to 5 (with 5 being highest importance). This compressed time scale was used because (a) generally, respondents are too optimistic if given a five-year "out date" and (b) a two-year horizon provides a more sensitive indicator of real trends and plans.

The arrangement of ratings follows the same general order for technologies as presented in Chapter III. As in Chapter III, a few technologies were not rated by the expert panel because they were recognized as having importance later in the assessment process.

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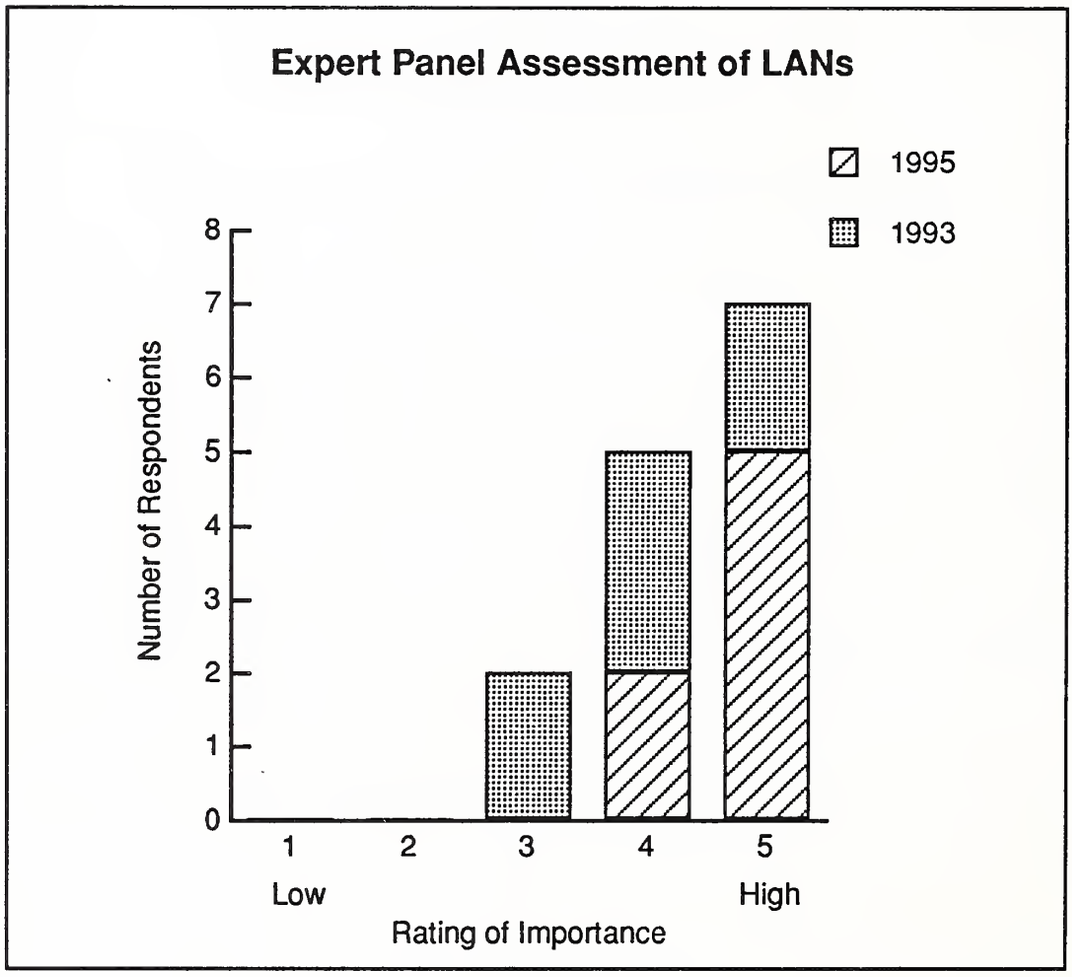
A
Panel Ratings in "Pervasive" Areas

Exhibits IV-1 through IV-5 show ratings applicable to the areas of pervasive technology specified in Section A of Chapter III.

Exhibit IV-1



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- The results in Exhibit IV-1 are somewhat surprising in that, not all vendors are on the "LAN bandwagon" yet.

- Exhibits IV-2 through IV-4 show that no single communications technology is seen as a "must-have" in the same way that LAN technology is. This shows that insufficient emphasis is being placed on ATM technology.

Exhibit IV-2

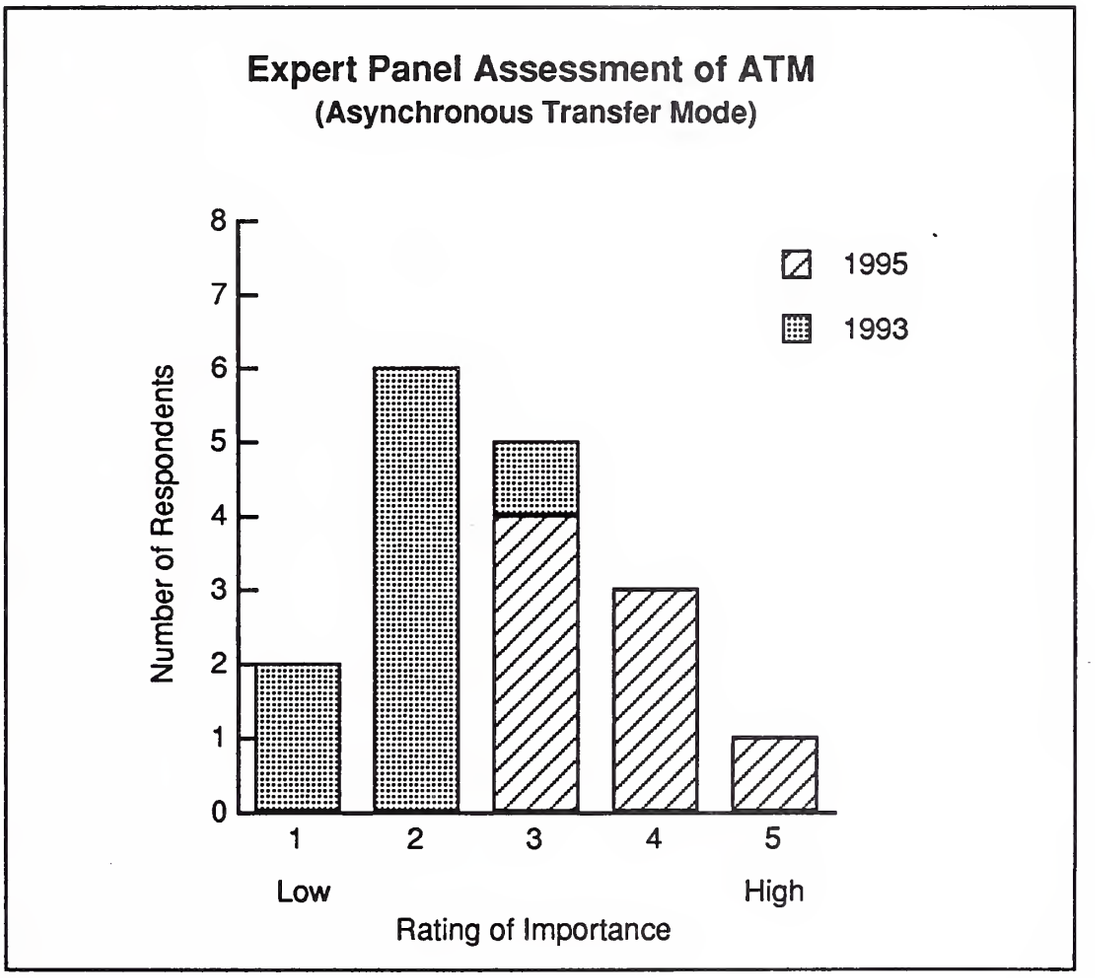

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Exhibit IV-3

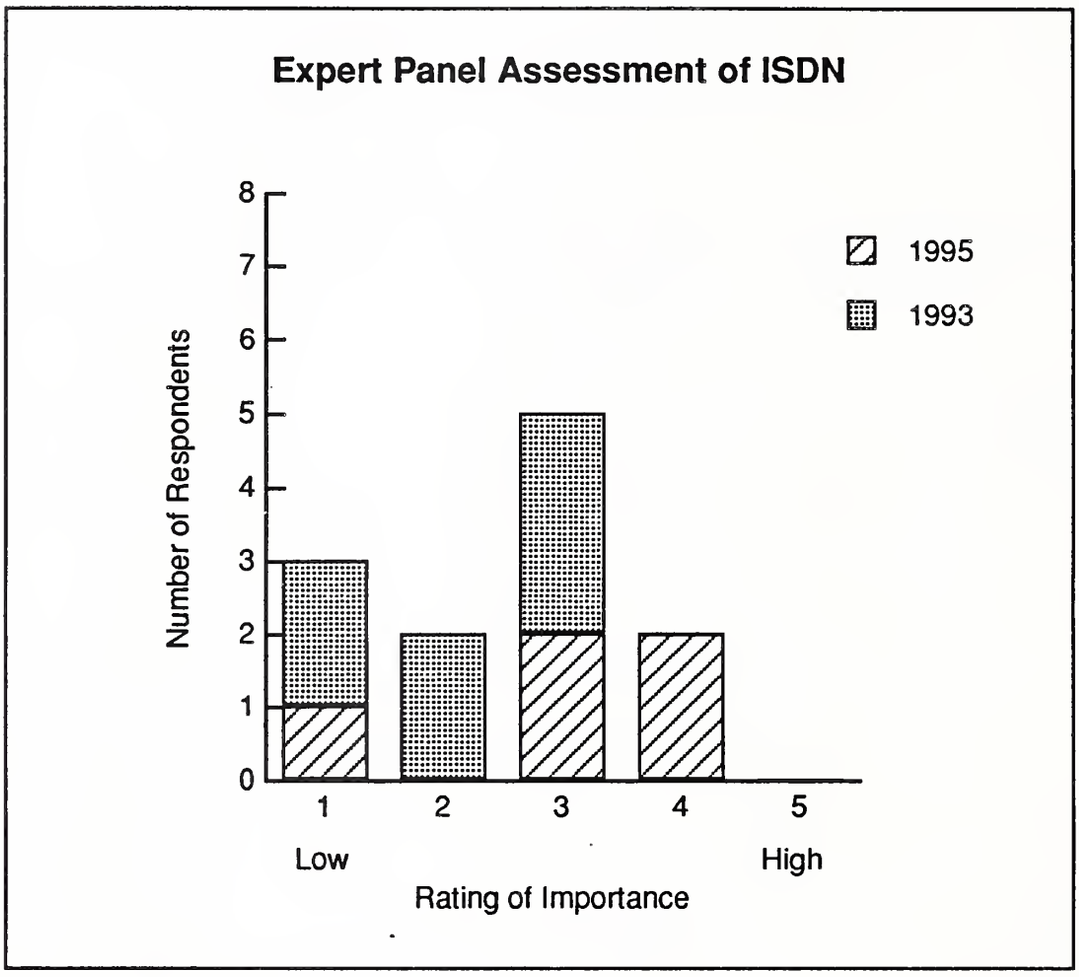

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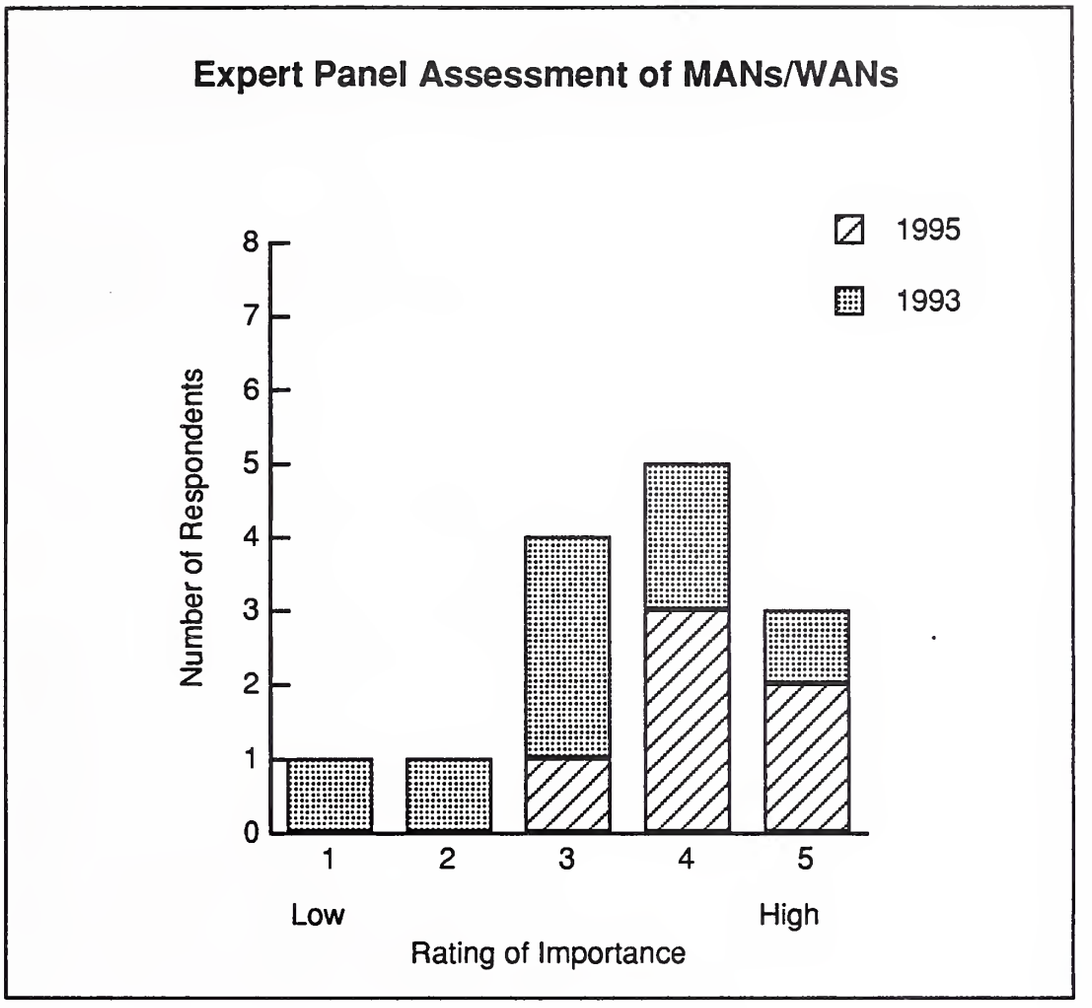
Exhibit IV-4



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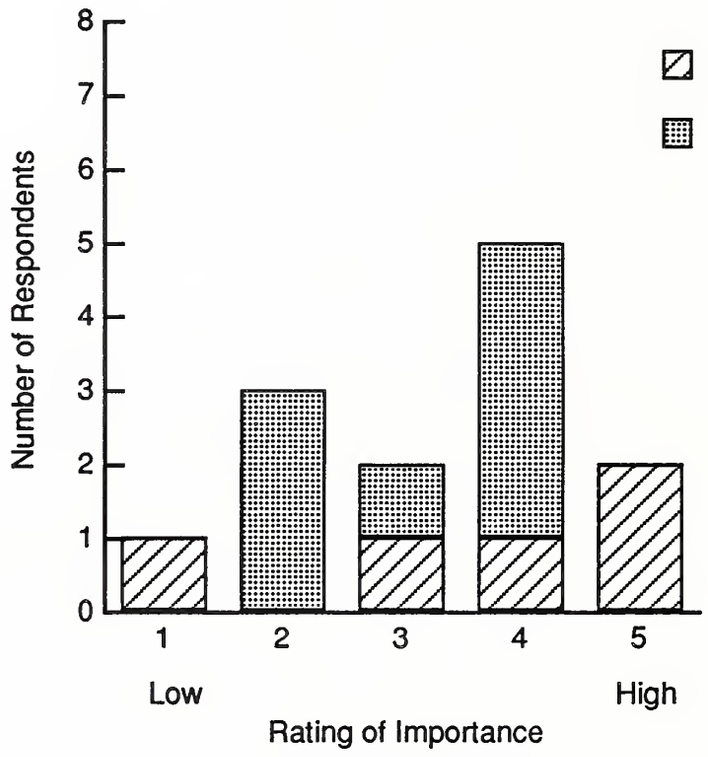
- Open systems initiatives (Exhibit IV-5) show a fairly low- (and variable-) sense of importance. One respondent even thinks this area will be less important in 1995.

Exhibit IV-5

Expert Panel Assessment of Open Systems Architecture



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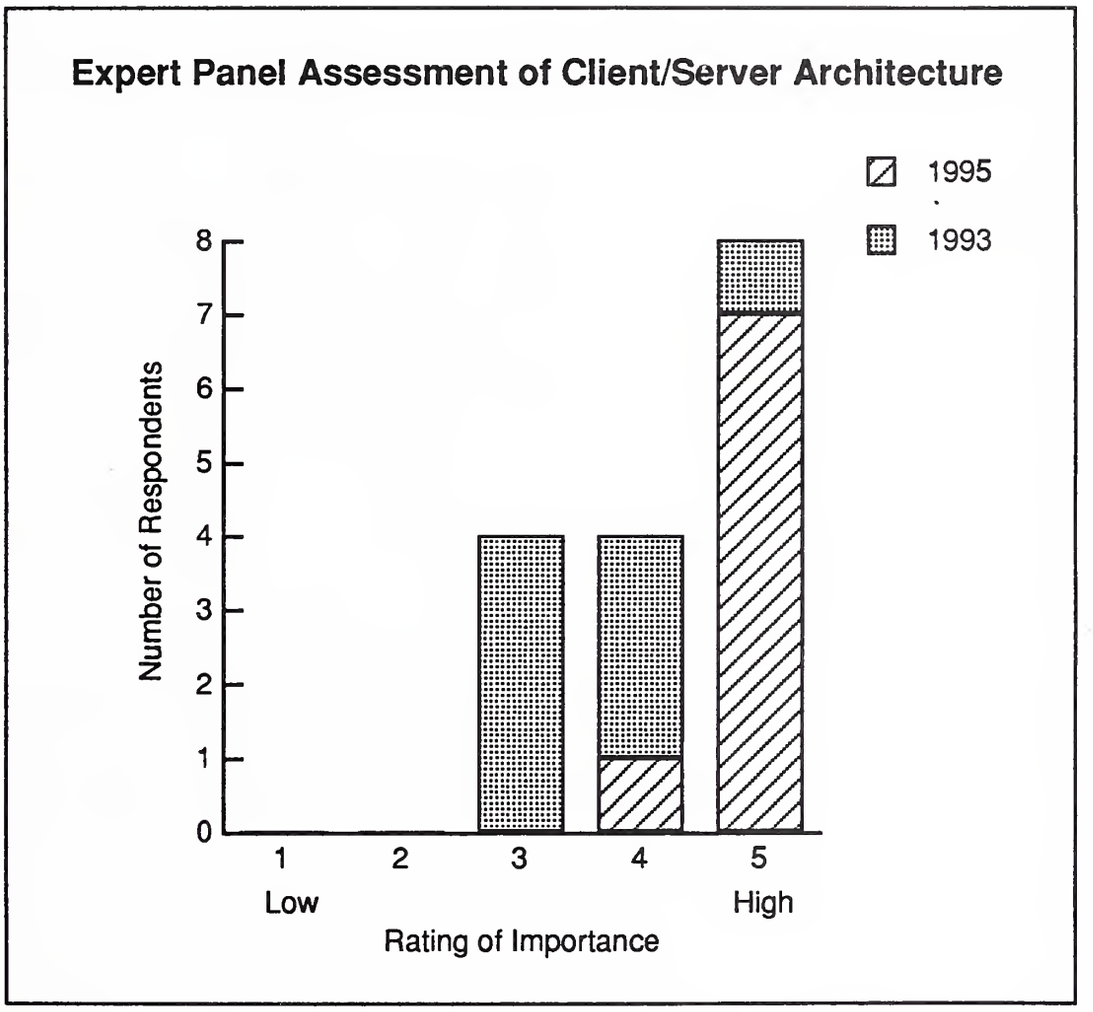
B
Ratings of Specific Technologies

Client/server architecture issues are rated relatively (and, in INPUT's opinion, surprisingly) low for 1993, although rising sharply by 1995 (see Exhibit IV-6).

Exhibit IV-6



The importance of object-oriented software makes one of the larger jumps in importance (see Exhibit IV-7), although there is, by no means, unanimity in the outlook.

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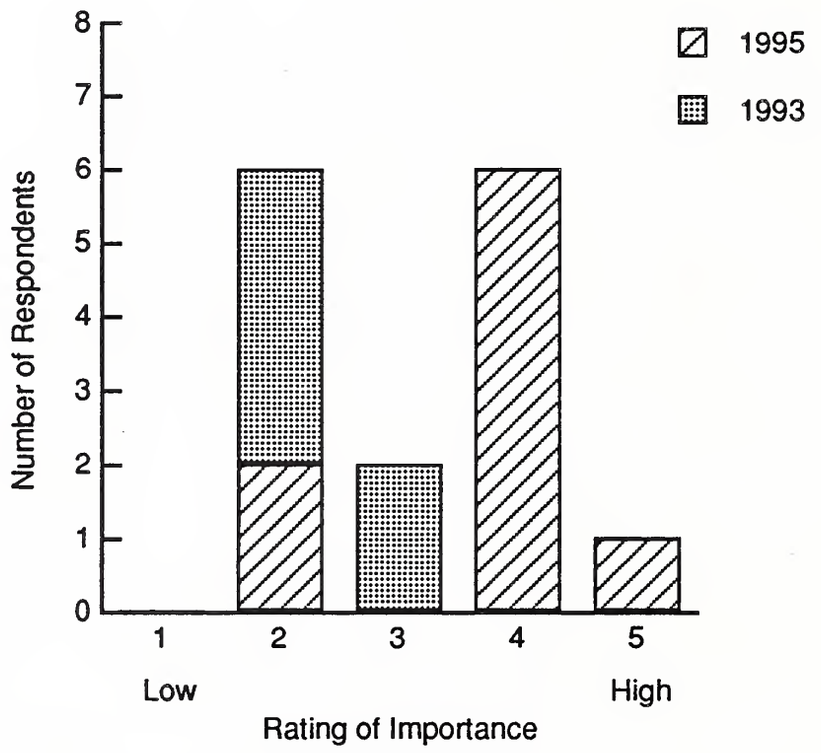
Exhibit IV-7

Expert Panel Assessment of Object-Oriented Software



EDI/electronic commerce (see Exhibit IV-8) shows a divergence of views that trends upward over two years. Speech recognition/ ID systems (see Exhibit IV-9) shows interest rising—this is an example of where a few vendors will be betting on hitting the jackpot.

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Exhibit IV-8

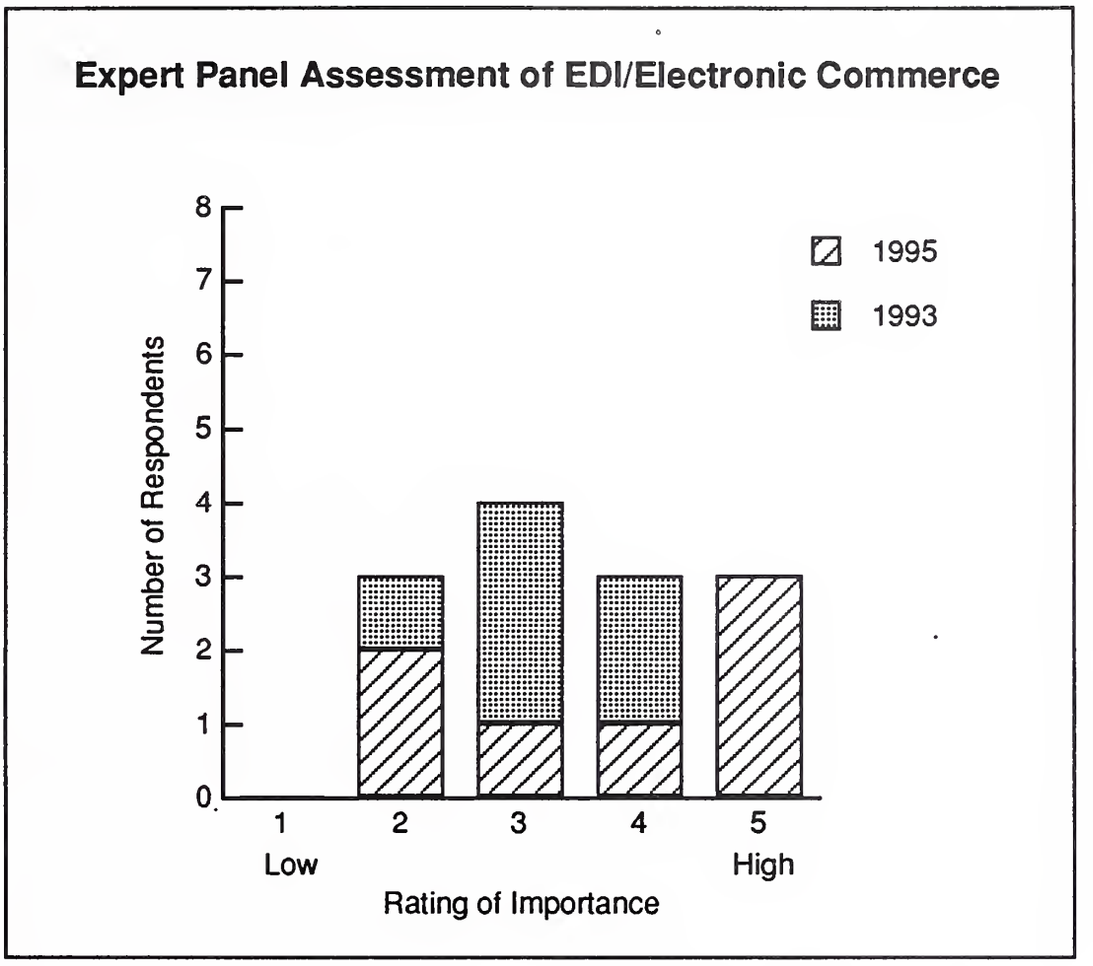

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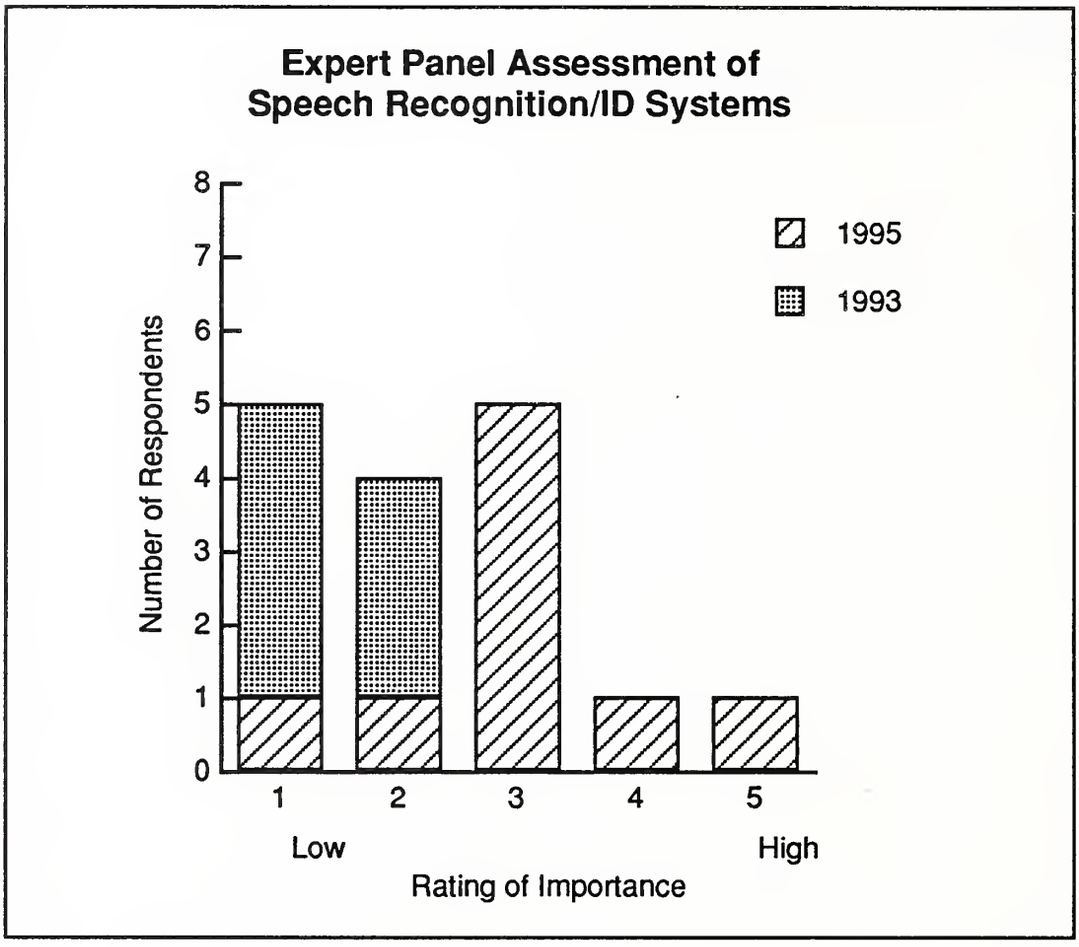
Exhibit IV-9



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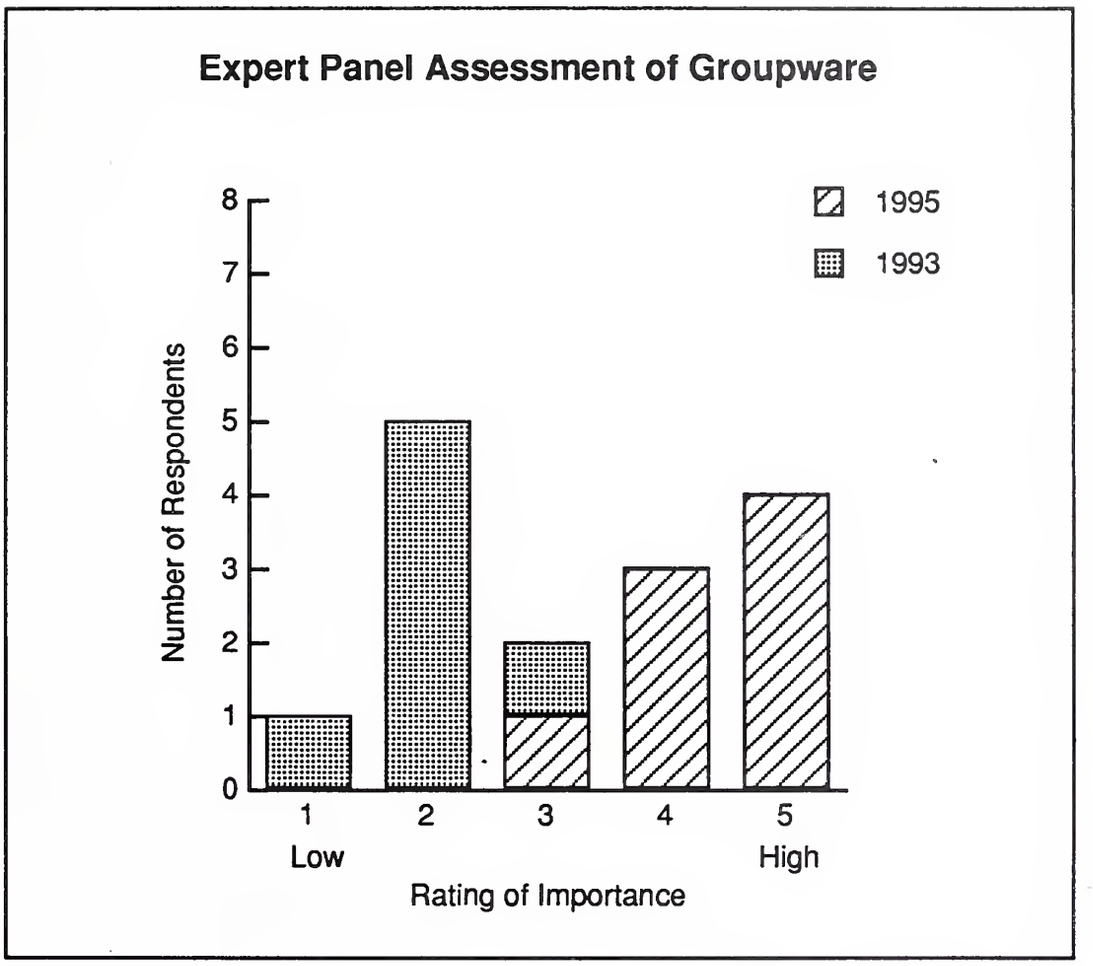
Groupware (see Exhibit IV-10) is seen as not very important now, but jumping upwards quite quickly by 1995.

Exhibit IV-10



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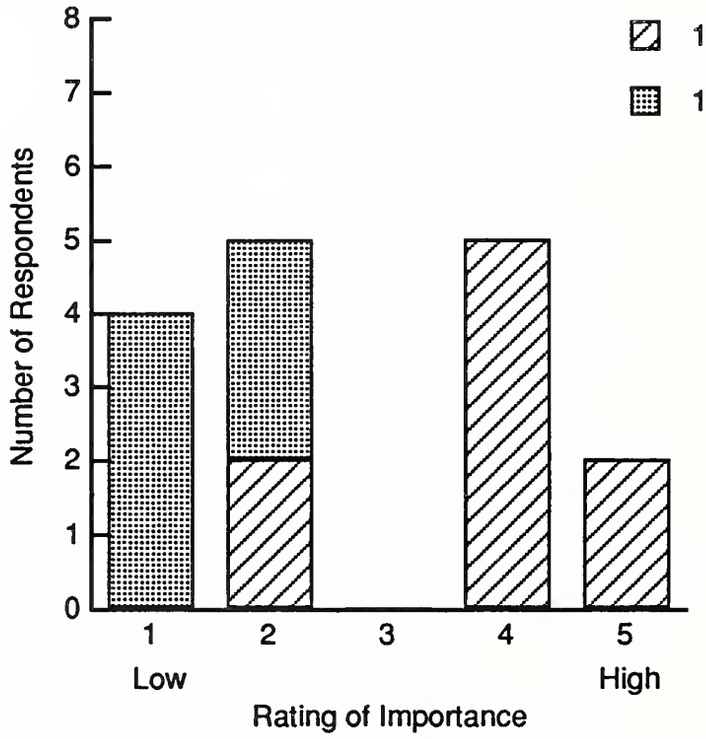
There is a shift in importance in mobile computing between 1993 and 1995 (see Exhibit IV-11).

Exhibit IV-11

Expert Panel Assessment of Mobile Computing (Wireless)



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PDAs, in general, and pen-based systems, in particular, (see Exhibits IV-12 and IV-13) are seen by many firms as becoming quite important in two years. However, there is a wide range of opinion on both the reality and the timing of this phenomenon.

Exhibit IV-12

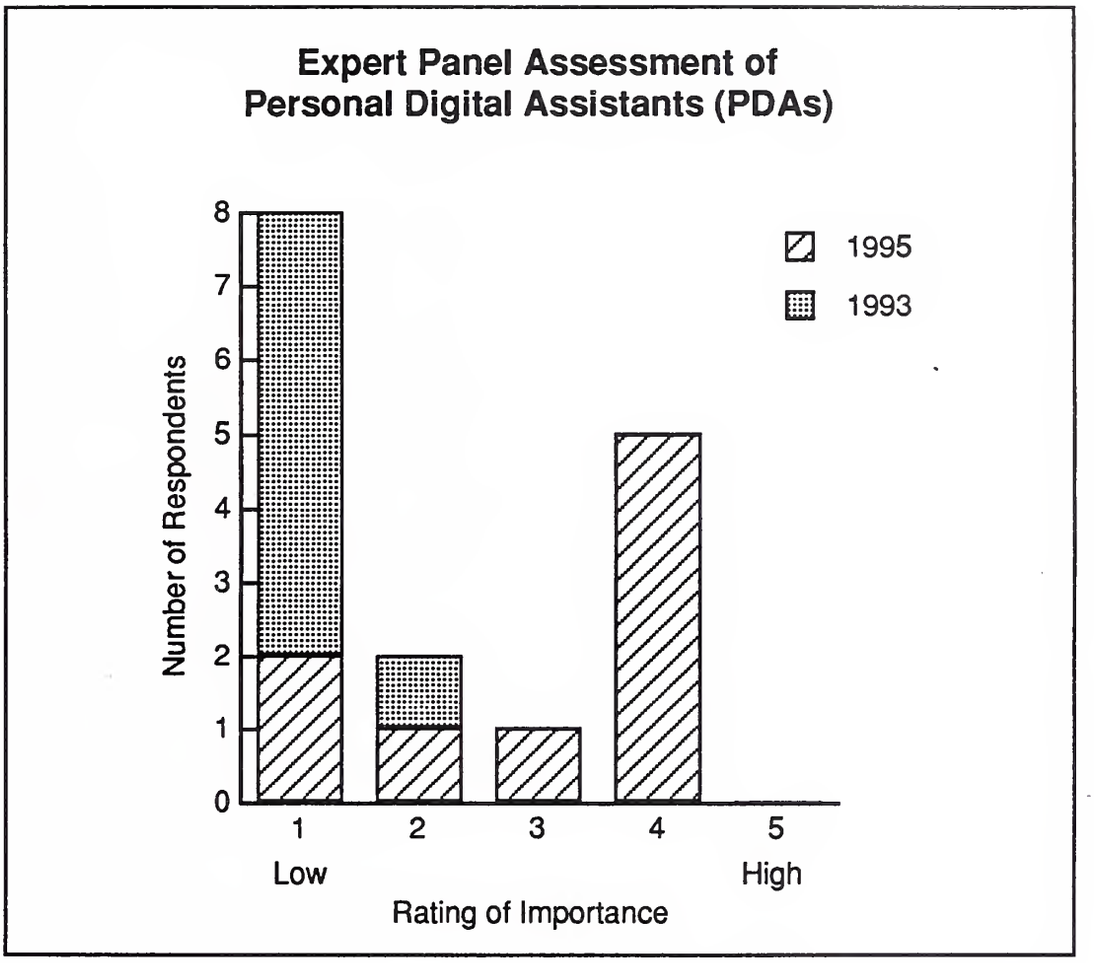

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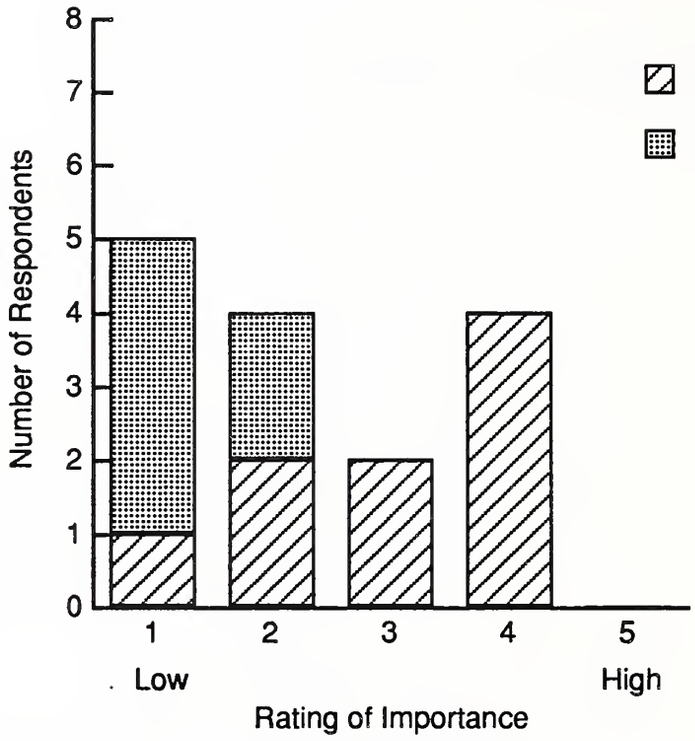
Exhibit IV-13

Expert Panel Assessment of Pen-Based PDA Systems



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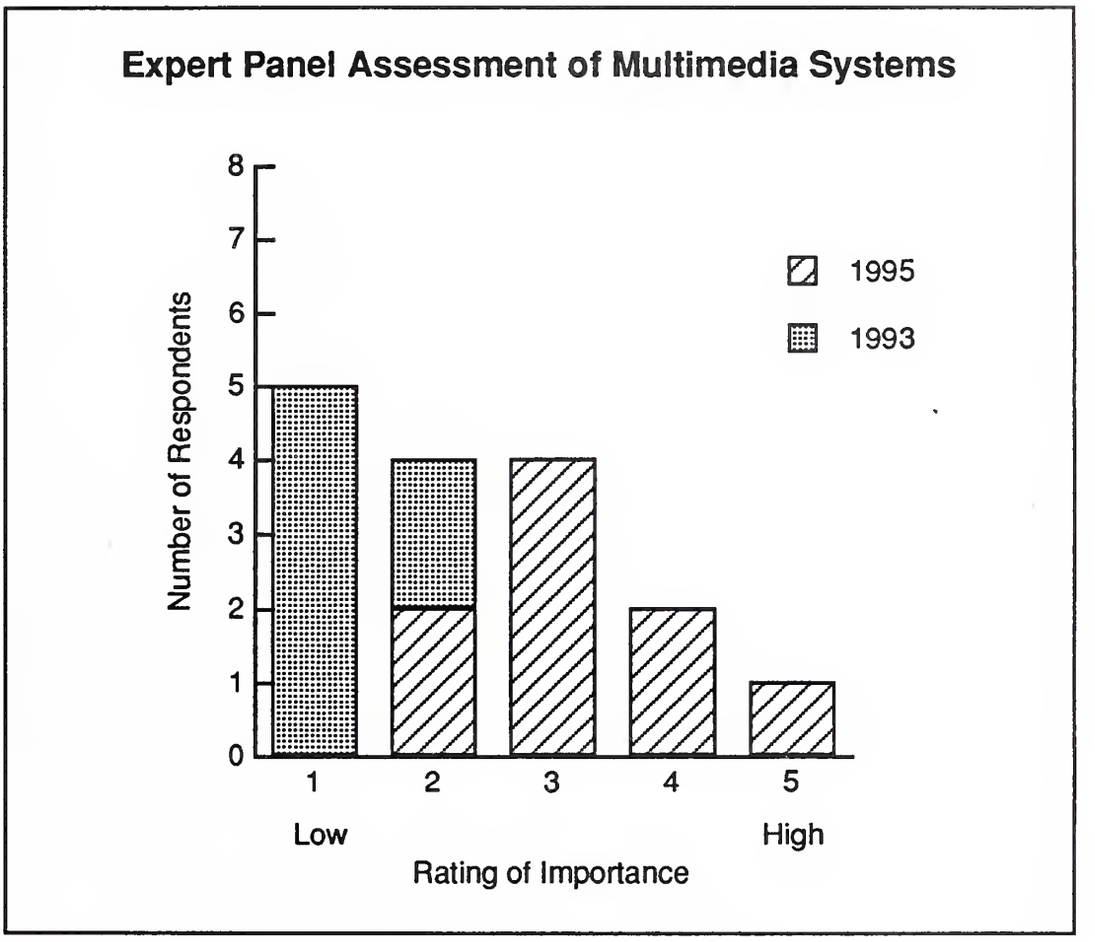
Multimedia systems (see Exhibit IV-14) are not seen as important now. However, the trend is definitely toward increased importance.

Exhibit IV-14



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Document/image processing and parallel processing are already seen as fairly important and increasing in importance (see Exhibits IV-15 and IV-16).

Exhibit IV-15

Expert Panel Assessment of Document/Image Processing

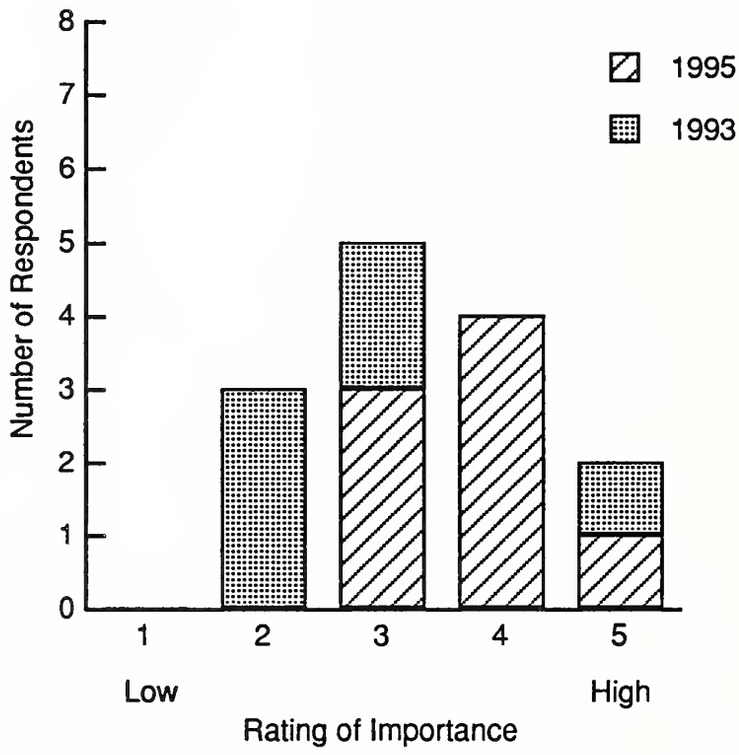

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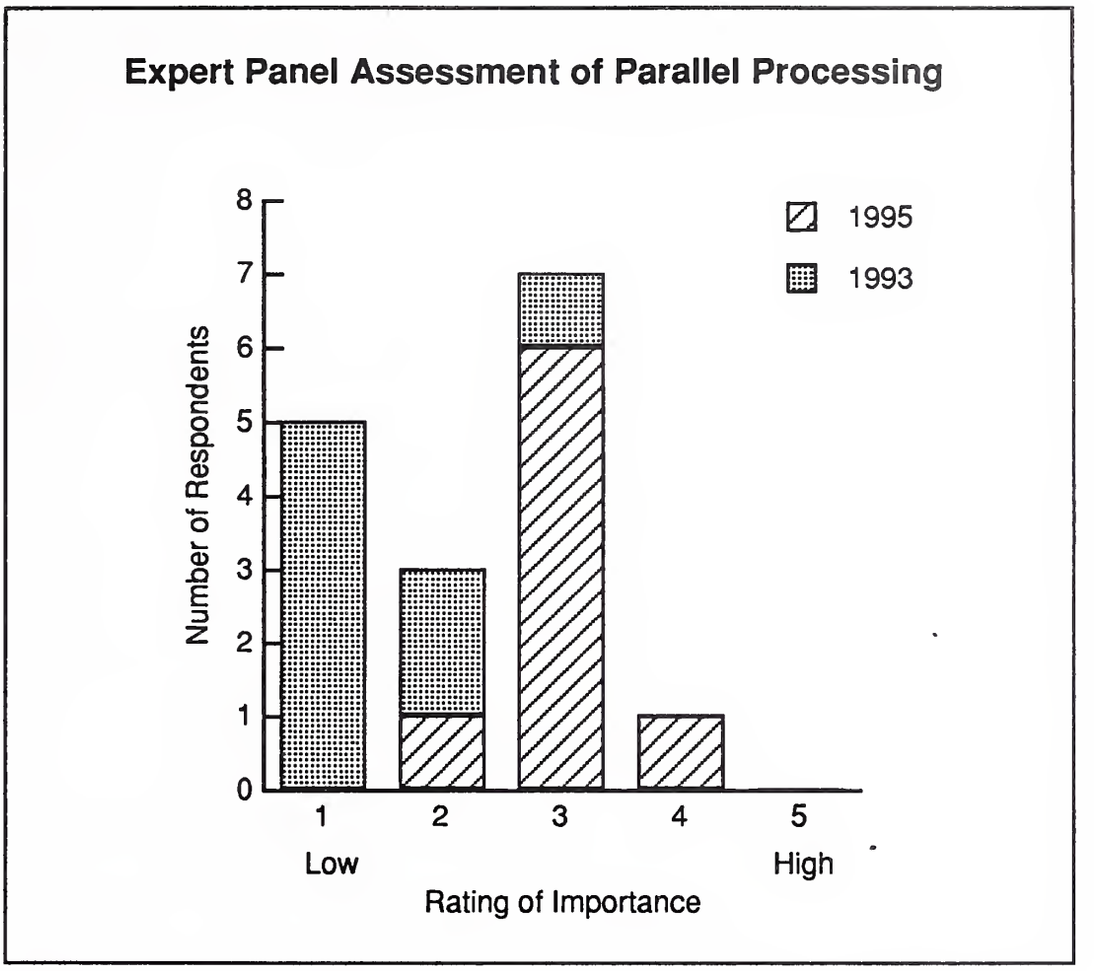
Exhibit IV-16



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Geographic information systems (GIS) and artificial intelligence (AI) expert systems (see Exhibits IV-17 and IV-18) are niche areas of moderate importance that will increase by about one level of importance by 1995.

Exhibit IV-17

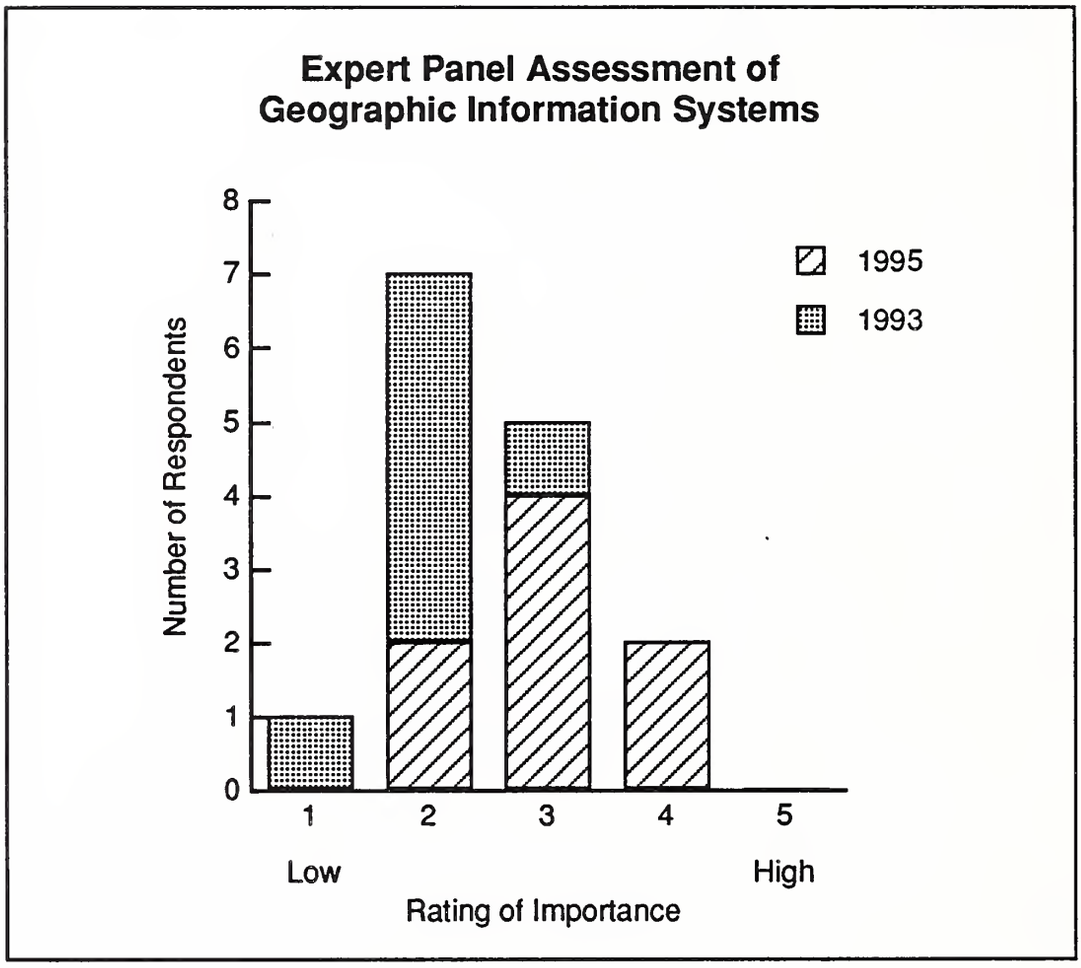

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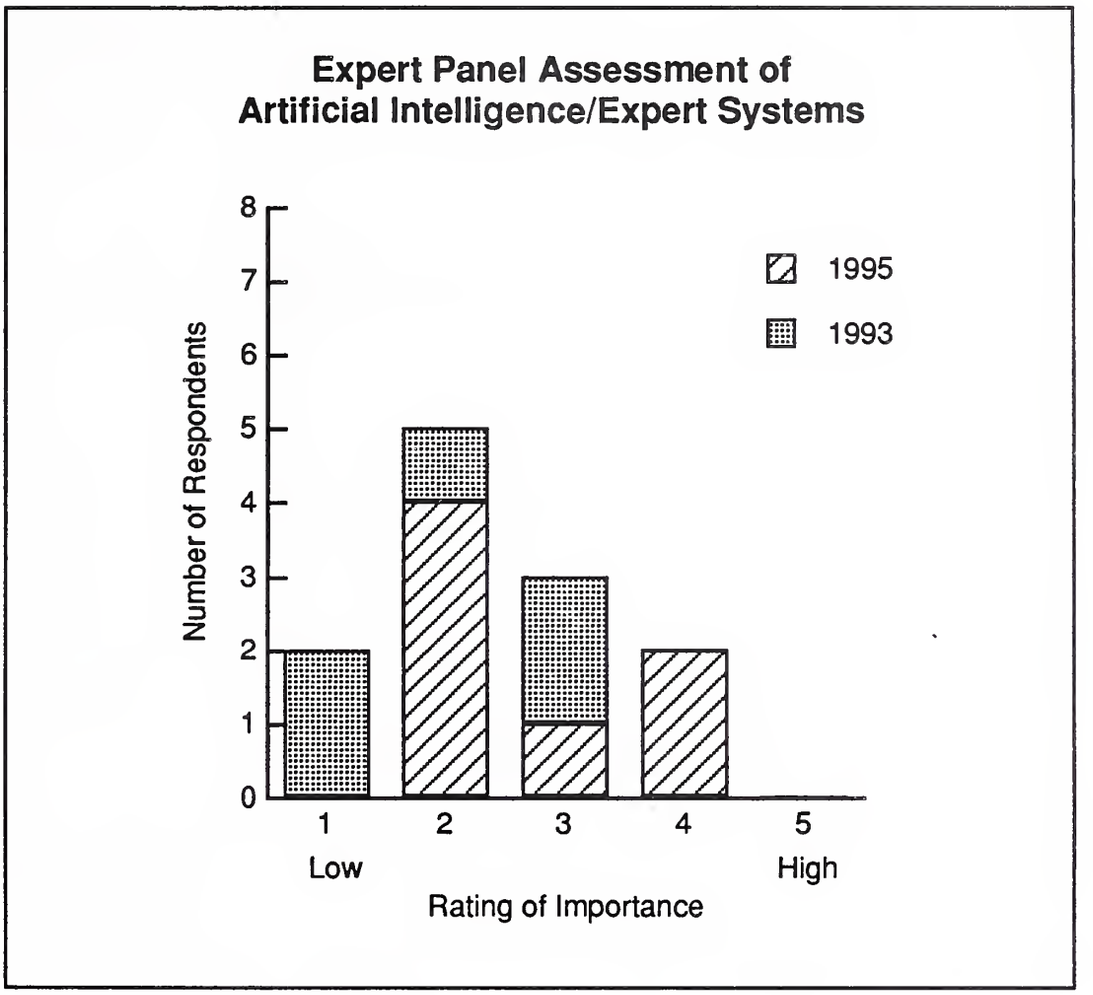
Exhibit IV-18



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C
Conclusions

As noted at the beginning of this chapter, opinions on technology importance vary widely, both now and in the short-term future. In part this is because vendors are uncertain of the direction of the technologies.

However, from the context of the interviews, this divergence is also caused by uncertainties within the decision making process in deciding which technologies will be funded. Resource decisions have several kinds of costs associated with them:

- Dollar costs (which may be significant in some cases)
- Allocation of scarce personnel
- Opportunity costs—if the direction taken is incorrect, this last cost may be the most important one.

Arguably, no vendor has the resources to be totally self-contained for all of the technologies discussed in this report. Very few would even consider this option. The most important challenge facing SI vendors is not technology, *per se*, but the priority setting process used in choosing technologies.

The following chapter endeavors to provide initial guidance on these issues of priority setting and planning.

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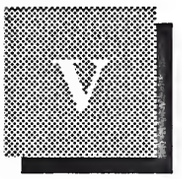

Technology Planning

INPUT believes there are two major issues involved in planning:

- Setting priorities between technologies
- Developing a process for managing the introduction and application of technology

A
Setting Priorities

One of the problems in priority-setting is that there appears to be so many distinct technology areas. One way to make priority-setting more feasible is to develop different ways to group technologies.

- Exhibit V-1 summarizes the findings from Chapter III by grouping the changes in importance of technologies from 1993 to 1998. Categories with the most change represent areas of higher opportunity, but also in most cases, higher rates of change, risk and cost.

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Exhibit V-1

SI-Related Technologies: Importance in 1993 and 1998

Importance in 1998	Low	Low/Medium	Medium	Medium/High	High
High		C/S DB	Comm Mgt.	C/S Appls	
Medium/ High	Object-oriented	• Mobile • PDAs • Multimedia Msg. • Groupware • Comm Sec. • Recognition	• Imaging • Workflow		
Medium	• C/S SW Eng. • Parallel Process. Dev.	• Multimedia Appls • AI • GIS			

Importance in 1993

Note: All entries within same box have equal importance

Source: Chapter III

- Exhibit V-2 shows a different sort of grouping by market technology.

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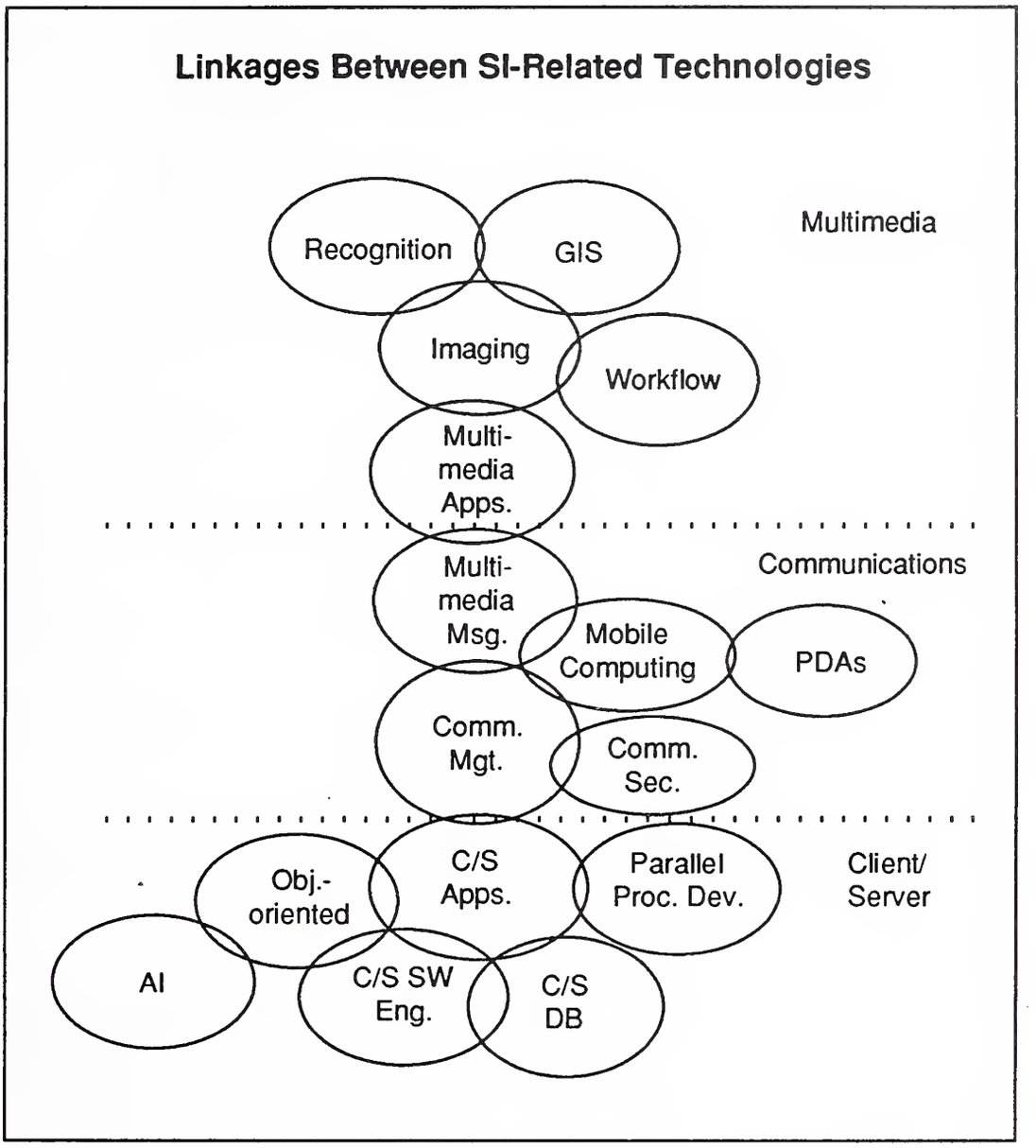
Exhibit V-2



- There are three main categories: Client/server, communications and broad multimedia.

- The individual technologies are listed within the major categories. Closely related technologies must often be considered together.

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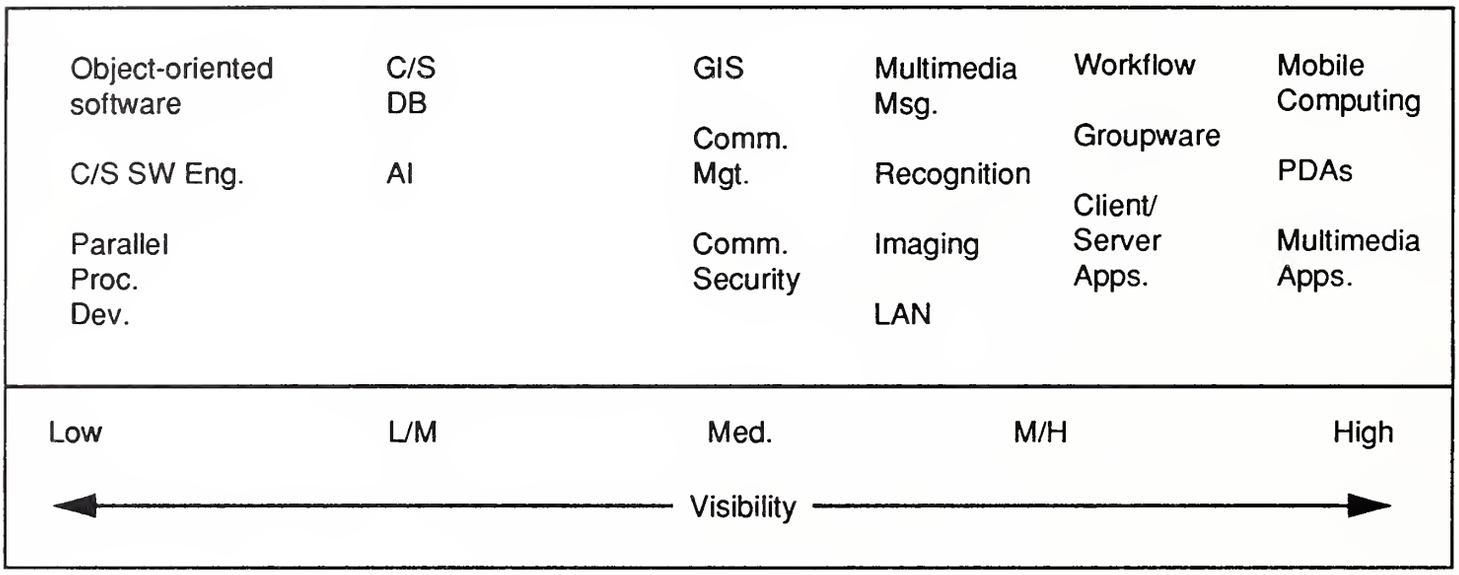
Another set of linkages are those from the customers' standpoint, i.e., the "visibility" of particular technologies—important technologies are not necessarily the most visible, and vice-versa. Exhibit V-3 divides technologies into "visibility categories."

Exhibit V-3

Visibility of Technology to SI Customer



- The highest group contains technologies that customers personally use or see. Customers tend to extrapolate importance and vendor competence based on what is closest to them personally.

- Almost as visible are the technologies that directly affect workgroups. Following closely behind are technologies with manifestations that are visible, even if the heart of the technology is not. LANs, of course, are by their nature, ubiquitous.

- The medium group of visibility contains GIS, that is very visible and specialized along with communications-oriented technology, that is sporadically visible, mainly when in trouble.

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- Both AI and client/server databases are important enablers but are generally only visible to specialists.

- The least visible group contains technology from the "engine room." Even though object-oriented software and client/server-oriented software engineering may be the most important long-term technology for SI firms, the long term does not produce near-term revenue and profits.

The most important analyses will be those performed by individual SI firms relating general market analyses, such as this report, to the business direction and associated technology appropriate for a specific organization.

The next section addresses the issues relevant to performing these analyses.

B

A Process for Managing Technology: A Technology Action Program

This section outlines an approach for SI vendors dealing with technology issues.

- A small part of the information in this section came from the expert panel responses. The expert panel admitted they and their companies had great difficulty in managing their own technology insertion.

- INPUT has drawn conclusions from both positive and negative observations formed in the process of providing consulting services for clients.

- The greater part of these recommendations have come about as a result of INPUT staff suggestions, based on their experience in the industry, and applied to this set of problems.

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1. Providing an Overall Planning Framework

An overall planning framework is the most needed, but least fulfilled, component of a technology plan. The key aspect is to conduct a recurring analysis of technology needs and capabilities. The most important factors to consider include:

- Potential contributions of different technologies
- Associated costs
- Timing of costs and benefits
- Risks

The preceding factors allow priorities to be set. In almost all cases, technology capabilities will need to be enhanced, either internally or by use of external resources. Organizational relationships may have to be changed as a result of these decisions.

The remaining subsections discuss individual issues in more depth, while Exhibit V-4 provides a diagrammatic overview.

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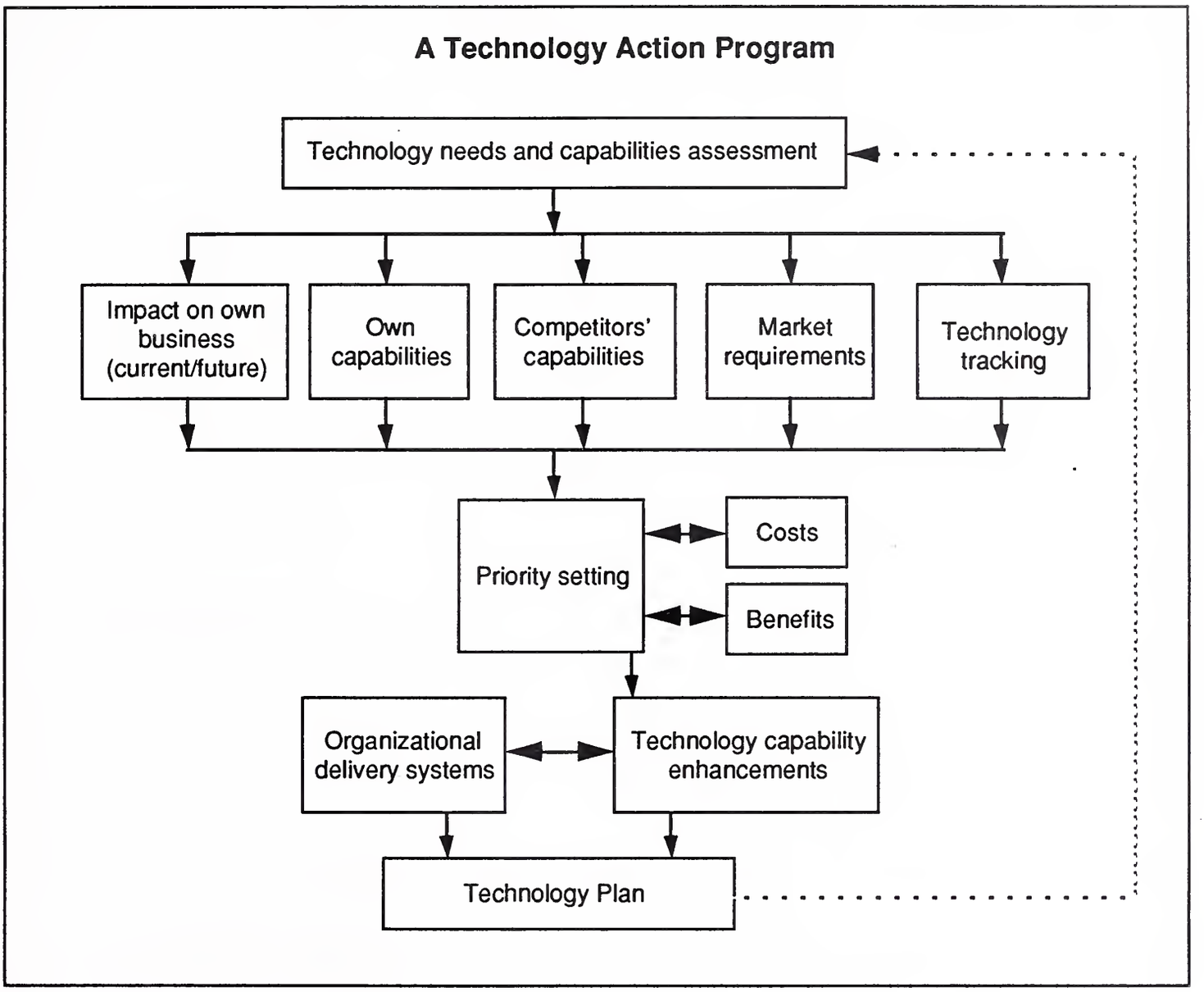
Exhibit V-4



2. Assessments of Market Needs and Impact on Business

Each technology (or technology group) will need to be assessed for its impact, both current and future, on the vendor's business. Factors that should be considered include:

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- Assessment of market impact/need (current/future) of selected technologies, taking into account

  - Applications
  - Business solutions
  - Vertical markets

This assessment should be made in the context of the strengths and weaknesses of the current business and also of future objectives.

- Revenue/profit traceable to a technology

  - From technology itself ("standalone" contribution)

  - Differential effect on larger offerings ("embedded" contribution)

- Future impact on business (by application, vertical market, etc.), given various assumptions, including:

  - Capabilities of the technology
  - Level of investment
  - Impact on offerings

3. Assessment of Technology Capabilities

Additionally, the technology capabilities of the vendor's own organization need to be assessed. Steps include analysis of:

- Components (for each technology), with minimum and optimum rankings

- Organizational strengths and weaknesses

- Depth of capability (e.g., number of qualified staff)

- Future requirements and direction

In addition, there should be an assessment of selected technology capabilities of major competitors, using the lists just described.

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Both internal and external assessments are necessary because both absolute and relative strengths and weaknesses are important for setting priorities.

4. Tracking/Assessment of Selected Technologies

A small group should be assigned to track technology developments, including:

- Customer expectations, derived from:
  - Market research
  - Feedback from customers/prospects
  - Feedback from assignments
- In-house work, including:
  - Experiments
  - Research
  - Beta testing (of others' products)
- On-going interaction with leading edge entities
  - Early adopters (clients/nonclients)
  - Universities/research organizations
  - Product suppliers (hardware, software, communications)
- External technology assessments
  - Consultants
  - Seminars
  - Research programs

5. Options for the Enhancement of Technical Capabilities

There are several alternatives to be considered for enhancing technical capabilities:

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- Internal staff

  - New hires
  - Training
  - Formal
  - On-the-job
  - Acquisition

- Alliances

  - Product providers (hardware, software, communications)
  - Research groups, universities
  - Service providers (e.g., network, transaction processing, EDI)

- Outsourcing/subcontracting (Examples)

  - Telecommunications
  - Nonpriority professional services (e.g., programming, support)
  - Systems operations

6. Organization/Delivery Options

Technology can be delivered in a number of potentially complementary ways, including:

- Technical centers

- Technical initiatives coordinated through line operations (matrix management)

- Seeding technical capabilities into line operations

- Turning selected capabilities into a profit center (direct or indirect sales/provisioning)

- Developing technology-rich application modules

Many of these delivery alternatives may represent changes in the way business is currently conducted or organized. Vendors will need to use the change management practices they offer to clients, applying these same practices internally.

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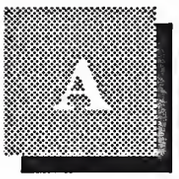

Definitions

A
Overall Definitions

1. Systems Integration

Systems integration is a business offering that provides a complete solution to an information system, networking or automation requirement through the custom selection and implementation of a variety of system products and services. A systems integrator is responsible for the overall management of a systems integration contract and is the single point of contact and responsibility to the buyer for the delivery of the specified system function, on schedule and at the contracted price.

To be included in the information services market, systems integration projects must involve some application processing component. In addition, the majority of cost must be associated with information systems products and/or services.

The systems integrator will perform, or manage others who perform, most or all of the following functions:

- Program management, including subcontractor management
- Needs analysis
- Specification development
- Conceptual and detailed systems design and architectures

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- System component selection, modification, integration and customization
- Custom software design and development
- Systems implementation, including testing, conversion and post-implementation evaluation and tuning
- Life cycle support, including
  - System documentation and user training
  - Systems operation during development
  - Systems maintenance
- Financing

2. Technology Definitions

The following are definitions of the technologies viewed as having a significant impact on the future strategy and design of systems integration services. These technologies are:

Object Technology - A software development technique based on the concept of an object. An object is a software "package" that contains a collection of related procedures and data. Procedures are called methods in the object approach. Data elements are called variables because their values can change over time. Object technology includes object-oriented programming, object databases and object-oriented operating environments.

Artificial Intelligence/Expert Systems - These are related terms, with many companies relating artificial intelligence to expert systems. Expert systems are defined as a structured set of logic that permits a system user to arrive at an answer based on the results of a series of predefined questions.

Document Image Processing - Also called electronic image processing, these systems are typically based on microcomputer technology. They are comprised of a micrographics subsystem and a computer subsystem. Text and images are stored using micrographic and digital technologies. Computer subsystems

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permit indexing, file manipulation, and input and output of stored information. Workflow technologies, designed to organize and manage a multistep process, can be a part of document image applications such as claims processing.

Geographic Information Systems - Or GISs, allow data to be dynamically presented in relation to specific geography. The GIS stores mapping information and merges that information with other non-mapping-related data sources.

Speech Recognition - Technology that compares the spoken voice to a prerecorded voice message. Speech recognition technology can be used to input voice commands, such as to a word processor, and eliminate some or all dependence on manual command procedures. Other applications include medical records entry or personal identification.

Groupware - A class of software in which a set of programs that can be integrated to allow data to be collected, stored, organized and disseminated among many users of a network. Lotus Notes and Microsoft Windows for Workgroups are examples of groupware products.

Open Systems Architecture - Through the Open Systems Interconnection (OSI), an open systems architecture will enable computers to communicate regardless of their location, operating system, network topology or manufacturer.

Client/Server Architecture - The interaction of one or more PCs or intelligent workstations on local-area networks (LANs) with a mainframe system, in some form. Typically, a server is a central repository for programs and data. The client then requests these elements for a specific application. Actual processing may be split to some extent between the client and the server.

EDI/Electronic Commerce - Application-to-application exchange of standardized business documents between trade partners or facilitators. Specialized translation software is typically employed to convert data from organizations' internal file formats to EDI interchange standards. This software may be provided as part of a VAN service, or may be resident on an organization's own computers.

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LANs - Local-area networks, or LANs, are the connection of a number of personal computers or workstations in a department. Through a gateway or router, a LAN may be connected to another LAN or a mainframe computer.

MANs, WANs - Metropolitan-area networks (MANs) and wide-area networks (WANs) are the interconnection of PCs, workstations and mainframes organization-wide.

ISDN - Or Integrated Services Digital Network, is a set of specifications for building digital telephone equipment. ISDN provides a common transport protocol for PC networks, telephones, faxes and any other equipment conforming to the standard. All devices can share a single digital cable, eliminating the need for many cabling infrastructures. ISDN transfer rates are in the 1.5 megabits per second range.

Mobile Computing (Wireless) - The ability to access and share business applications, data and programs from a remote location. A portable computer with a modem is the first essential technology. The PC may be used to access an information service or a dial-in server. A traditional modem, requiring a wire connection, will be replaced by wireless communications using cellular or satellite technology.

ATM (Asynchronous Transfer Mode) - This is a recently developed universal network transport mechanism. ATM provides a common infrastructure suitable for applications that include desktop, LANs, metropolitan-area networks (MANs) and global networks. ATM accommodates high-bandwidth applications such as multimedia, document image processing and videoconferencing. ATM transfer rates are approximately 50 megabits per second up to the 1 gigabyte per second range.

CD ROM - Or Compact Disk Read Only Memory, is an inexpensive medium for the mass distribution of information. A laser, similar to those used in audio compact disks, is used to read data from a specially formatted compact disk. Each disk holds approximately 630MB of information, many times the capacity

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of magnetic diskettes. However, CD ROM disk drives take longer to access data than magnetic diskettes. CD ROM technology is used extensively for distributing multimedia applications programs and their related data files.

Multimedia / Vision Systems - This technology most often is based on a microcomputer platform. The technology allows the integration of sound, computer graphics (especially animation), and support for analog and digital video. The most effective multimedia platforms include high-performance microcomputers, high-performance CD ROM storage drives containing programs and data, and sophisticated sound generation components.

Personal Digital Assistants (PDAs) - Personal digital assistants are a subset of pen-based systems. These are lightweight hand-held consumer electronic devices packaged with highly intuitive software that is data-compatible with the existing applications platforms. Special operating systems will allow PDAs to provide fax, electronic mail, word processing and other services. Communications will be critical for any PDA architecture. The development of wireless communications standards will allow true portable computing. Casio and Sharp (based on Apple's Newton intelligence system) are representative PDA manufacturers. GeoWorks is a sample software supplier, with its Geos object-oriented GUI.

Parallel Processing - A system architecture in which processing tasks are distributed across more than one processing resource. Once these subtasks are completed the results are consolidated and presented to the originating program. This division of tasks may be managed by a hardware implementation, a specially designed operating system or a combination of these approaches.

Pen-Based Systems - Microcomputer systems in which the primary input device is an electronic pen. The pen is used to write on electronic "paper," the screen of a hand-held computer. Pen-based systems include letter-sized clipboards and tablets, palmtops, convertibles and personal digital assistants.

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